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[OFFICIAL NOTICE.]

January Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, Dec. 26, 1896.

The January meeting of the Society of Gas Lighting will be held in the works of the New York Mutual Gas Light Company, Eleventh street and Avenue D, New York, at 3 P.M., of the 14th prox.

FRED. S. BENSON, Secretary.

[OFFICIAL NOTICE.]

January Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, Dec. 24, 1896.

The January meeting of the Guild of Gas Managers will be held in Young's Hotel, Boston, Mass., at noon of Saturday, the 9th prox.

A. K. QUINN, Secretary.

BRIEFLY TOLD.

THE STATE OF TRADE.—The closing days of 1896 show that the prevailing conditions in the gas trade are of an abnormal nature, in that their revealments are in no sense coherent, which state of affairs is in sharp contrast to the developments which immediately preceded and followed the recent election. In the fortnights before and after the 3d November the figures received by us as to the outputs of the reporting companies showed fair gains, that could be considered indicative of a general improvement in the trade the country over; but the output statements since then are not in accord with the tenor of the November ones. This finding applies to the reports from all sections, and perhaps more particularly to the vicinity of and about New York. In the Eastern States, the companies of the cities and towns, where manufacturing concerns figure as prominent factors in the trade and living of the respective localities, report losses in sendout that are clearly traceable to the doubt or uncertainty that governs the inactivity of possible proprietors of the many factories, who fear interference through the action of the general government in the instance of tariff changes, with the ordinary course of their trade. Perhaps the tariff dickerers will in time learn that what may be called personal legislation for profit on the one hand, or political effect or preferment on the other hand, is most distasteful to the vast majority, who are neither manufacturers nor politicians, but who positively desire that stability, in some measure, as users of the goods of the factory men, or as adherents of any party policy, shall be their portion. In a word, the prevailing feeling is one of uncertainty, and the suppliers of gas, in common with other like vast business interests, are experiencing the mental ups and downs that influence those whose faith is tinctured with unbelief. There is, however, a circumstance in connection with it all which is quite reassuring, so far as the gas trade is concerned. Despite the fact that sendout figures are not in conformity with those that we were led to expect from the earlier returns of November, it is certainly true that inquiries, from the proprietors of average-sized gas works, of manufacturers, respecting cost of projected plant improvements to be carried out in the next building season, are very much in evidence. We might say that such inquiries have not been so numerous or so important since the winter of 1892. A possible explanation for this plethora of inquiries may lie in

the thought that, since the close of 1892, the ordinary gas man has carried on his avocation at as small an expenditure on plant account as was possible, even though such cramping caused him to work under an uneconomical system. But, whether so or not, his presence in the market, as a prospective purchaser of apparatus, goes to show that, in the main, he is at least as well off now as he was at the opening of 1893. The difference in sendout, too, it might be said, as between November, 1895, and November, 1896, so far as our test figures show, is, on the average, less than 1.5 per cent.

TWO DIFFERENCES EXPLAINED.—Last week we had occasion to say that the proposed Exhibition of gas appliances could no longer be considered in a sense other than that designated by the word success. It is our further pleasing task to say that the developments of the week, in respect of the Exhibition, have been in a direction confirmatory of our expression of a week ago. The interest in the Exhibition is constantly gaining in force, and the net result is sure to be of vast benefit to the gas industry; for the local gas interests and the interests of the intending exhibitors have been so solidified that failure is simply impossible. We have been informed, however, that our reference of last week to the "gas tower," which it is proposed to make the crowning glory of the Exhibition, was not sufficiently transparent in the instance of making it known whether the "tower" was to be constructed at the expense of the Messrs. Tiffany, or at the expense of the Gas Industries Company. From our point of view (and we imagine that those of our readers who ever had anything to do with the famous house named in a practical way will share our belief), we took it for granted that the Messrs. Tiffany were not famed for giving very much away, so we thought our statement that the Tiffany's were to erect a "gas tower" at Madison Square Garden, for the purpose outlined, was sufficient declaration that the Gas Industries Company had promised to pay them for its construction. To put at rest any lingering doubt on that score, the Tiffanys will construct the "tower" and erect it; the Gas Industries Company will pay for it. This much for the first apparent difference in our last week's reference to the Exhibition. The second variance is one that is real. We said that the evening of Wednesday, February 4th was to be set apart as "Gas Men's Night" at the Exhibition. February 4th will mark the close of the meeting of the Ohio Gas Light Association, which body, as announced in prior issues of the JOURNAL, has decided to hold its next annual meeting in New York, during the time of the Exhibition, rather than in Ohio at the place originally named; but February 4th, 1897, falls on Wednesday instead of Thursday. It is no excuse, of course, for our failure to name the day and date accurately, to say that both, in the course of the preparing of our announcement, were accepted from the copy, received by us from the Gas Industries Company, of the matter that the Company wished to take the place of the advertisement respecting the Exhibition which has been running in our advertising columns; but such was the case.

NOTES.—The negotiations looking to the amalgamation of the gas and electric lighting interests of Little Falls, N. Y., were practically completed last week. Under the terms of the bargain all the properties of the Little Falls Gas Light Company, the William Henry White Electric Light Company, and the Little Falls Electric Light and Power Company, have been taken over by the United Gas and Electric Company, of Little Falls, which will thus have control of the situation. The capital of the Company will be $100,000, and the bonded indebtedness $75,000. The officers of the new corporation are: President, Mr. Watts Loomis; Treasurer and General Manager, Gen. W. F. Lansing; Secretary, Mr. Ed. T. Lansing. The new Company has purchased the mill property, with the valuable water rights on the Mohawk river, formerly owned by the A. T. Stewart estate, and the electric plant will be removed to one of the buildings of the named property, which is well fitted for the purpose to which it is to be devoted.——M. I. Clark has been granted a franchise for the operation of a gas and electric plant in Mason City, Ia., for a term of 25 years.——Mr. Robert G. Scherer, of Albany, N. Y., who will again represent an Assembly district of Albany in the next Legislature, is rather outspoken in his belief that gas rates in the principal cities should be reduced.——As a companion piece to the notice in our current item columns, of the proposed formation of a free lance opposition Gas Company, to operate in what may be called the Connecticut River Valley, we may say that another concern, known as the Milford Electric Light and Gas Company, will apply to the General Assembly of Connecticut for the right to supply gas in Orange, Derby, Huntington, Seymour, Beacon Falls, Naugatuck, Waterbury, Watertown, Plymouth, Thomaston, Litchfield, Harwinton, Torrington and Winchester.——The new plant of the American Gas Company's branch at New Rochelle, N.Y., is quite up to the promises of its constructors and the expectations of its purchasers.——There is some talk of an opposition gas works at Amsterdam N. Y.

Domestic Illumination by Means of Gas.

[The Second of a Series of Three Cantor Lectures, delivered by Mr. Vivian B. Lewes, F.I.C., F.C.S., before the Society of Arts, London, England.]

The history of our industries always impresses us with the great utility of brisk competition; and in no case is this more marked than in the utilization of gas for the emission of light. From 1820, when Neilson, of Glasgow, first discovered the principle of the union-jet burner, and gave the world an easy, and at the same time a fairly effective, method of consuming the then newly introduced illuminant, until quite recent times, coal gas had been consumed by the methods which had sufficed for illumination in the early days; and in all probability those methods would have continued in the same inefficient groove up to the present time, had it not been for the appearance of electric lighting in the latter part of the seventies, and the dread which suddenly arose in the minds of those interested in gas manufacture as to the effect of this brilliant competitor on their commercial status. It is true that the germs of important methods of consuming gas had already been sown; but the time had not been ripe for their development; and it was only the absolute necessity of combating the inroads of electricity that caused the adoption of new and improved methods for developing the light latent in coal gas. In the early fifties, Dr. Frankland had already pointed out that the heating of the air supply to a flame marvellously increased the light which that flame emitted; but it was not until Siemens, Clark, and others, worked the idea into practical form that the completion was effected of the regenerative or recuperative burner, which certainly marks the greatest advance ever made in the hygienic consumption of gas.

The fact that the luminosity of a coal gas flame depends upon the number of carbon particles liberated within it, and the temperature to which these can be heated, at once points to the fact that the methods by which the light developed from a flame *per se* can be augmented, are the augmentation in the number of the carbon particles by increasing the material that will deposit them, or by raising the temperature to which the particles already present have been heated. While the first process is carried out by enrichment, the second is best obtained by regeneration.

It seems improbable that any great advance in the results already achieved in this direction is possible, as with enrichment one could not get beyond the results obtained from pure acetylene; and the action of regeneration is limited by the power possessed by the material of which the burners are composed to withstand the superheating. Consequently, although, with a perfectly made recuperative burner, it might be possible for a short time to get as high a duty as 16 candles per cubic foot from ordinary coal gas, such a burner constructed of the usual materials would only last a few hours. For practical use and a reasonable life for the burner, 10 candles per cubic foot is about the highest commercial duty to be reckoned upon.

This limitation naturally caused inventors to search for different methods by which the emission of light could be obtained from coal gas other than by the incandescence of the carbon particles contained within the flame itself; and the fact that a coal gas flame consumed in an atmospheric burner under conditions necessary to develop from it its maximum heating power could be utilized to raise to incandescence particles having a higher emissivity for light than carbon, led to the gradual evolution of incandescent gas lighting, which undoubtedly marks one of the most important eras in the history of gas as an illuminant.

The present systems of lighting by means of incandescent mantles mark the perfection of many years of experimental toil and disappointment before the desired goal was reached; and from the day when Talbot, in 1855, first noticed that a piece of blotting paper soaked in a solution of calcic chloride and burnt in the flame of a spirit lamp left a white network of ashes, which heated in the feeblest flame emitted a brilliant light, down to the latest developments of the Welsbach mantle, there have been thousands of experimental failures and stillborn attempts, the records of which have neither seen nor created light.

That all solids can be made to emit light when heated to a certain temperature, has, of course, always been known; while the fact that at any given temperature some substances would emit more light than others, gave rise to the Drummond or lime light, in which a block of lime, raised to the highest possible temperature by the intensity of the oxy-hydrogen or oxy-coal gas blast, emitted a light which until the advent of the electric arc light remained unrivalled. The amount of material, however, which had in this case to be raised to incandescence rendered this very high temperature necessary; and it was gradually

recognized that if, instead of a block of lime, a basket work of thin filaments, made of lime and magnesia, could be employed, better results would follow, as, instead of the costly oxy-hydrogen or oxy-coal gas flame, an ordinary gas and air blowpipe, working at a slight pressure, could be used. This idea was practically adopted in the Clamond mantle, which was probably the first oxide mantle which had any extended commercial being; while the same principle was applied in the Fahnehjelm comb, which was afterwards used for water gas.

The Clamond mantle, as shown at the Crystal Palace Electric and Gas Exhibition in 1882-3, consisted of a conical basket composed of threads of calcined magnesia, which were formed by making a mixture of the hydrate and acetate of magnesium converted into a paste or cream by means of water, and then moulded and ignited; the heat decomposing the acetate, which in its partial fusing during decomposition formed a luting material that glued into a solid mass the particles of magnesic oxide produced, while the hydrate gave off water and became oxide. The basket was supported with its apex downwards in a little platinum wire case; and a mixture of coal gas and air was driven into it from an inverted burner above.

Long before this oxide mantle made its appearance, however, Lewis introduced a mantle constructed of fine platinum wire, which, raised to incandescence by a blast of air and coal gas, gave for a certain period what was then considered a very high duty for the quantity of gas consumed. But the rapid falling off in its power of emitting light proved a fatal obstacle to its commercial success. This deterioration was due to the surface of the platinum becoming eroded, partly by the formation of traces of carbide of platinum from the action of the hydrocarbon in the flame, and partly by the deposition on its surface of traces of foreign metals due to the breaking up of carbon-oxyl compounds, of which the gas contained minute traces; and this trouble it was which at a more recent date militated against what at first appeared a very promising attempt to utilize thin platinum iridium wire for the manufacture of an unbreakable incandescent mantle.

Leaving these forerunners of modern systems of lighting, we come, in 1886, to the first appearance of the Welsbach system of incandescent mantles, which, after nine years of struggle and effort, has at length attained a well-earned and phenomenal success. Dr. Auer von Welsbach, whose researches on the rare metals and their compounds had already gained him a great reputation, conceived the idea of making a mantle of refractory oxides by the processes which had been previously shadowed forth by Talbot and others. In order to do this, he took an open fabric of cotton, steeped it in a solution of the nitrates of the metals from which he required the oxides, and then, having dried it, burnt off the organic matter; while the heat of this process converted the metallic nitrates present in the interior of the cotton fiber into oxides, which retained the form of the fabric from which the skeleton had sprung. Step by step improvements were introduced into the mechanical processes employed, and into the combination of metallic oxides of which the incandescent material was composed, until a point has now been reached which as far as light emissivity is concerned has never been equalled in the utilization of coal gas.

The commercial success attained by the Welsbach mantle has naturally caused an enormous number of attempts to be made to improve on the mantles already in use. But though, in some cases, these attempts have shown considerable promise, the Welsbach mantle still remains at the head; and as legal decisions have given the Company working this system what is practically the exclusive right to use the oxides of those earths which appear most fitted for yielding high emissivity, together with long life for the mantle, it is evident that their rivals must aim at obtaining mantles which shall be free from some of the more prominent defects which the Welsbach mantle possesses. In view of the great interest which the subject of incandescent lighting now affords, it will be well to discuss the directions in which possible improvements in incandescent lighting are to be found.

The first most essential portion of the incandescent gas apparatus is the burner, the flame from which must be itself non-luminous, as otherwise deposition of carbon on the material heated would rapidly bring incandescence to an end. Non-luminosity may be obtained either by using atmospheric burners in which the mixture of air and gas is made before combustion takes place, or by the consumption of coal gas in a sheet so thin that air can permeate it with sufficient freedom to render it non-luminous. The former of these methods is employed in nearly all systems of incandescent lighting; while the latter is used in Paris in one form of the De Mare light fringe, which is heated by flat flame burners so small as to emit no light from the flame.

The large demand for atmospheric burners created by their extended use for incandescent mantles, has done much to improve their manufacture, and to bring out the factors which it is necessary to observe in obtaining the highest heat duty by the combustion of the gas. One of the most promising directions in which this has taken place has been the gradual realization of the fact that, in order to obtain the best results, it is necessary to have the mixture of air and gas not only in such proportions as to give the most perfect combustion, but also that the mixture itself shall be so perfect in every part that the molecules of the combustible flame constituents and the oxygen with which they are to combine shall find themselves side by side in every part of the mixture when the moment of combustion arrives, as the intensity of the flame must of necessity be greatly increased by the proper regulation of this factor.

Perfection of mechanical mixing has long been recognized as an absolute necessity where equality of result and maximum effect have been required in such high combustibles as gunpowder; and the rough and streaky admixture of air and gas which takes place in an ordinary Bunsen burner is in much the same condition in regard to its effects as the powder produced by Roger Bacon. In our present burners, in order to obtain the maximum effects, we ought to aim at making the gas and air into as perfect a mechanical mixture as we find in the highly-finished gunpowders of to-day. Attempts have not been wanting in this direction; and such burners as those introduced by M. Denayrouze aim at doing this by mechanically churning together the gas and air before combustion. But such burners require a motor of some kind, which renders them clumsy and costly; and therefore it would be far better if a successful method could be introduced where the gas and air could be made to thoroughly mix in the right proportions without the aid of external mechanism.

In wading through the mass of literature dealing with the subject of atmospheric burners, one finds that, in 1891, M. Chemin took out a patent for making a Bunsen burner in which the gas, entering at the bottom, passed up through successive cones, in each of which admixture with fresh portions of air took place; so that, instead of the air being drawn in by the uprush of gas in the burner tube in one operation, as is the case with the ordinary Bunsen burner, the influx of air would take place in successive portions, which tends to give a better admixture of the two. This is not of itself sufficient to give any very great increase in the heating effect to be obtained from the burner. In the same way, it has from time to time been proposed that the mixture of air and gas before combustion should be passed through shields of wire gauze, which, while preventing the flashing back of the air and gas at the nozzle of the burner, also helps in completing the admixture. But here again no great increase was obtained until M. Bandsept, by combining these two principles, and by making a head to the burner which should give a decreasing instead of an increasing resistance to the flow of the gas and air, and by making what he terms "atomizers," consisting of several layers of wire gauze at the point immediately before combustion takes place, gets a far more complete admixture of the combustible gases; while his injection cones are so arranged as to give a maximum induction for a given pressure. These being surrounded by a movable outer casing perforated with small holes for the introduction of the air, enables him to obtain his air supply in a large number of small streams at a low pressure; and the effects produced by this burner are distinctly an advance upon any appliance of the simple Bunsen type previously made.

There is no doubt that this is the right direction in which to look for improvement in the consumption of gas and air, and experiments made by Mr. F. Livesey, the Chief Engineer of the South Metropolitan Gas Company, show that, even when the mixture of gas and air made in an ordinary Bunsen burner is allowed to flow for some distance through a tube, increased heating effects may be produced through diffusion of the gases during their travel together under conditions which equalize their pressure. But there is no doubt that, with the gas traveling up the tube of a Bunsen burner at a more rapid rate than the air current which it induces, the velocity to a great extent prevents diffusion taking place in any considerable degree, with the result that, as the mixture issues from the mouth of the burner, it consists of "slices" of air and gas of different degrees of mixture rather than of a perfect mingling of the two. Experiments made with the Bandsept burner have led to its adoption by the Welsbach Company in Paris; and the results obtained by reliable observers show that a very great gain in the duty of the mantles used with it is obtained. My first impression on working with it was that it would not prove so effective in England, with a comparatively low pressure of gas, as had been found to be the case in Continental cities, where higher pressures exist. But extended experiments lead me to believe that there are greater possibilities in its use.

In a Bunsen burner, the chemical actions which give rise to the heating consist of two distinct combustions. The first takes place on the surface of the inner visible cone of the flame, where the hydrogen and hydrocarbons of the coal gas undergo a partial combustion at the expense of the oxygen of the air, which has been previously mixed with the coal gas, and which results in the combustion of the carbon to a mixture of carbon monoxide and dioxide, while some of the hydrogen is burnt to water vapor—the outer flame being produced by the combustion of the hydrogen and carbon monoxide, escaping from the inner zone into the completed products of combustion, carbon dioxide and water vapor.

The characteristic appearance of the Bunsen flame varies according to the quantity of air allowed to enter with the gas. Under normal conditions, the zones of flame have a violet blue color; but as more and more air is allowed to enter, the flame becomes fiercer, and the inner zone acquires a green tint. A still further addition of air causes the mixture to become so highly explosive that it flashes back into the tube of the burners. [The lecturer here illustrated this by experiment.] During this change in the color of the flame, alterations are taking place in the temperature which the various parts are emitting; and the following table gives an approximate idea of the increase which takes place with the addition of more and more air, and which reaches its maximum as an explosive limit is approached:

Temperatures of Bunsen Flame with Blue and Greenish Inner Cones.

	Blue Inner Cone.		Greenish Inner Cone.
Tip of inner cone	1,090°	..	1,575°
Center of outer cone	1,533	..	1,630
Tip of outer cone	1,175	..	1,545
Side of outer cone, level with tip of inner cone	1,333	..	1,511

The ratio of gas to air in the blue and greenish non-luminous combustions is about—in the blue, 1 volume of gas to 2.27 volumes of air; and in the green, 1 of gas to 3.37 of air. The reason of this is that the less air that is supplied to the center of the flame, the more has to be introduced from the exterior; and while the interior supply has been heated by the passage up the hot tube, and by partial combustion in the inner zone, the outer supply is cold. As not only the oxygen which is used by the flame has to be heated, but also four times its volume of diluting nitrogen, it is manifest that the less external air that is sucked into the flame, the higher will the temperature of the external portion of the flame become; and as it is this part of the flame which is utilized for heating incandescent mantles, it is clear that this will give a gain in the amount of light to be obtained from the mantle itself. In the Bandsept burner, it is possible to so regulate the mixture of air and gas that not only is the green zone in the interior of the flame formed, but, owing to the explosive point being reached, it is drawn down on to the surface of the top of the gauze forming the "atomizers," or mixers, through which, however, it is unable to pass. The flame therefore consists of what is practically only the outer cone of the ordinary Bunsen; and, being fairly homogeneous, it has a greater equality of temperature than can be obtained with the ordinary flame.

[Leaving the question of the burner, the lecturer passed on to describe the mantle and the method of manufacturing it.]

In the early days of incandescent lighting, no process was known of rendering the mantle sufficiently strong to bear carriage; and it had therefore to be sent out unburnt, and had to be burnt off when it was required. But as the success of the mantle is almost entirely dependent upon the shape fitting the flame to which it is adapted, and as the burning of it to that shape requires considerable practice, this was a very great difficulty. Another complication arose from the fact that the metallic nitrates were so acidulous in their nature that the mantles soaked in them quickly rotted away unless after they had been soaked they were exposed to the action of ammonia gas, which converted any excess of acid into ammonia nitrate. But it was found that this so-called ammoniation rendered the mantles, after they had been burnt, even more fragile than before. The reason of this is to be found in the fact that the ammonia gas converted the easily fusible and decomposable nitrates into hydrates, which were practically infusible, so that the pressing together into a coherent mass by the contraction of the organic matter on burning could not take place; and the mantle as often as not dropped to pieces as soon as burnt off. It was therefore a great advantage when it was discovered that the burnt-off mantle could be dipped in collodion—*i.e.*, a solution of soluble gun-cotton in a mixture of alcohol and ether, which, when the mantle is drawn from the solution, evaporates, and leaves a thin film of collodion cotton, so strengthening the skeleton of metallic oxides that they could be stored and sent from place to place without danger of fracture.

The oxides used in the first Welsbach mantles made in this country consisted of mixtures of zirconia, lanthana, and yttria, or zirconia and lanthana. But not only were these very fragile, but they only emitted from 4 to 6 candle power per cubic foot of gas consumed. After gradual changes and modifications, the composition of the present highly successful mantles is 98 per cent. of thoria and 2 per cent. of ceria; and the average performance of these mantles may be taken as being an emission of 16-candle power for a consumption of 1 cubic foot of gas. If the fragility of the mantle allows it to bring its life to a natural termination, it will last for a very considerable period. The light does not show any serious diminution during the first 500 hours; but it then gradually drops away, until at the end of 1,000 hours it has lost about 40 per cent. of its original power of emitting light. But it must be clearly borne in mind that any such expression concerning the life of a mantle is very misleading, as the fragile nature of these appliances most frequently causes their premature demise from fracture. If one took the life of a Welsbach mantle from the general average of all mantles sent out, it would be a great deal nearer 100 than 1,000 hours; as personal experience with these beautiful but delicate fabrics teaches us that many more mantles are lost in the first 10 hours of existence than are nursed to a ripe old age of 1,000 hours.

But little is at present understood as to the causes which lead to the wonderful power of emitting light that these mantles possess. I think, however, there is but little doubt that this must be due to some specific molecular changes which are taking place in the material employed, as unless this were so, it would be practically impossible to find an explanation of the fact that the mantle of thoria alone emits practically no light, while the addition to it of 1 to 2 per cent. of ceria excites the power of emitting light to the high degree found in these mantles. If mantles are made from any one oxide alone, no very startling illuminating power can result; and the following table shows the approximate value per cubic foot of gas to be obtained from each oxide when used for mantle making by itself:

Thoria, commercial	6.00
" pure	1.00
Zirconia, commercial	3.10
" pure	1.50
Ceria	0.90
Yttria	5.20
Lanthana	6.00
Erbia, commercial	1.70
" pure	0.60
Alumina	0.60
Chromium oxide	0.40
Barium oxide	3.30
Strontia	5.50
Magnesia	5.00

Ceria gives a reddish yellow light; erbia, zirconia and barium, a yellow light; alumina, a whitish yellow light; strontia and magnesia, a white light.

From this it is seen that neither thoria nor ceria, when pure, has any particular power of emitting light. But if 1 to 2 per cent. of ceria is mixed with the thoria, the mixed oxides at once emit a light from 14 to 16 times greater than either of the substances used; while on increasing the ceria, the luminosity gradually drops until equal mixtures of the two give about the light one would have expected from the emissivity of the two constituents. It is generally accepted that the power of emitting light is dependent upon intense molecular activity in the luminous body; and it seems hardly probable that so small a trace of the ceria should have the power of setting up any chemical action which could induce luminosity, without the light-giving power being increased by the addition of more ceria, nor is it likely that the combination of so small a trace of ceria with the thoria should last over so long a period as that during which the mantle continues to emit light.

Some interesting experiments have been made by Dr. C. Killing on the cause of luminosity in incandescent mantles; and his conclusions are that it is due to the catalytic action, in a state of extremely fine division, of the oxide which is added as an excitant to the skeleton formed by the chief material of the mantle; and he finds that traces of metallic platinum or iridium, or even gold, osmium, ruthenium, and palladium act in a similar way as the ceria added to the thoria mantles. There is no doubt that if the skeleton of thoria be dipped into a dilute solution of platinum or iridium chlorides, small traces of these metals, in an extremely fine state of division, after heating will be formed on the surface, and that these will have a certain catalytic action such as

glowing when the gas is turned on to the mantle while it is still warm. But I do not think this is any proof that ceria and other oxides of the same character have a catalytic action of the same kind, though at a high temperature; and I certainly should have expected that, if such action was the true explanation of the phenomenon, further additions of the excitant to it ought to increase the incandescence, and certainly would not decrease it, as is the case. Dr. G. P. Drossbach has also made some interesting experiments on the light-emissivity of the oxides; and he comes to the conclusion that, when heated in a blowpipe flame, the light-emitting value of the separate oxides is found to be proportional to the formula—

$$\frac{\text{Molecular weight} \times \text{specific gravity.}}{\text{Specific heat.}}$$

With the heavy metals, however, the oxides are gradually reduced and vaporized in the flame, and these conditions alter if refractory oxides are introduced into the mantle with the reducible ones, as they behave as bases towards them, and allow the formation of more or less acid salts.

Another consideration is that ceria is by no means the only excitant that can be used to endow the thoria mantle with the power of emitting light; and it seems far more reasonable to suppose that the admixture of small traces of such bodies as ceria induce molecular changes in the state of the oxides, such as from the amorphous to the crystalline state—a change which may be excessively slow, and which has before been observed to induce high incandescence when bodies capable of undergoing it are being heated. Another example of the same character is to be found in the case of a mantle made of alumina, which emits no light, but which on being sprayed or dipped in chromic acid gives very good illuminating results. In this case, after an hour's heating, as far as chemical examination can tell, all chemical action has ceased, yet the power of emitting light continues for days, and cannot therefore be due to chemical action.

The color emitted by the mantle varies greatly with the oxides of which it is formed; showing that specific alterations in the rapidity of the luminous vibrations are caused by alterations in the composition of the mantle. Nothing could be more marked than the difference between the warm pinkish-yellow light of the "Sunlight" mantle, which is due to the incandescence of oxides of zirconia and alumina, or alumina alone excited by oxides of chromium, and the cold greenish-blue light of the Welsbach. Lighting by means of incandescent mantles is now assuming such important dimensions, that it behooves us to pay attention to every point in dealing with it; and it will probably be found that the color of the light emitted by such combinations as those at present utilized in the Welsbach mantles will have a distinctly injurious action upon the eyesight when continued over any long period of time. My own opinion with regard to artificial illumination is that it is an absolute necessity, in choosing a light by which we are to work, that it should be essentially different from ordinary daylight, and should be as free as possible from those actinic rays which Nature so largely utilizes in sunlight for her chemical work. It is manifest that Nature intended the eyes to be used during the hours of daylight, and that the strain on the optic nerve should be relieved by the periods of twilight and darkness. One can, however, without any great fatigue to the eyes, continue to use them for some hours longer, when the artificial light employed is of a soft character, and poor in actinic rays, such as is given by candles and oil lamps or the gas flame. But I fear that, when we continue to fatigue the eye with an artificial light rich in violet and ultra violet rays, in the course of a generation or so, the result of that fatigue of the optic nerve will begin to make itself manifest in the gradual deterioration of eyesight.

Very interesting experiments have been made by Professor Crookes upon the difference in the light rays radiated by the Welsbach mantle and in those obtained from the "Sunlight" mantle. These mantles, when under experiment, were burnt in a chimney which had in it a window of quartz opposite the brightest part of the incandescent mantle, so as to allow of the free transmission of all ultra violet rays of light; while the spectograph in which the spectra were photographed had a complete quartz train consisting of condensers, two double prisms, collimator and object glass. Under these conditions photographs were taken on isochromatic films, the experiment being carried out under such similar conditions as to be strictly comparable. Having so arranged the burners and the pressure of gas as to get the best light from each mantle, photographs of the spectra were taken; and in order to fix the wave lengths of any particular part, a spark spectrum of a standard alloy, the line of which had been carefully measured, was impressed on the plate immediately after the artificial spectrum was photographed. Working in this way, it was found that the extent of invisible radiation in which the Welsbach mantle exceeds the "Sunlight" mantle is largely comprised between the wave lengths 3,450 and 3,850; the total ultra violet spectrum of the light of the Welsbach mantle being comprised between wave lengths 3,450 and 4,000, whereas that of the "Sunlight" mantle is comprised between wave lengths 3,850 and 4,000. Arguing from these experiments, Professor Crookes says:

It is considered by authorities that light more than normally rich in violet and ultra violet rays is injurious to the eyes. They contribute in time to a partial destruction of the fibers of the crystalline lens, and when excessive, they produce erythema and symptoms resembling those of sunstroke. Men employed in electric light works, if frequently exposed to powerful arc lights, are affected in this way. It is not, however, desirable that the light should be too rich in yellow rays, as these temporarily destroy the erythropsine—the photo sensitive substance of the retina—producing great fatigue of the nerve, and requiring darkness for its re-formation and the restoration of normal vision. This destruction and re-formation is a natural accompaniment of the ordinary exercise of sight; but as the yellow rays are most active, it is advisable that they should not be in excess. For these reasons, the best form of artificial light is one containing little or no ultra violet rays, no excess of yellow rays, and just sufficient red light to communicate a warm, pleasant tone to the surrounding objects. The injurious effects of artificial lights on the eye being principally attributable to the invisible ultra violet radiation, the Welsbach light may be considered 2.5 times as harmful as the "Sunlight" mantle light.

In order to counteract as far as possible the injury and discomfort caused to the eye by such intense centers of illumination, it becomes necessary to use globes to obtain a better distribution of the light, and at the same time a protection to the eye. But in gaining this advantage a considerable sacrifice is generally made in light. For ordinary purposes, ground glass, opal or frosted globes are used; while in many houses these globes are made in pink tinted glass so as to neutralize the ghastly effect the Welsbach light gives to the complexion. With all such globes the loss of illumination is considerable and the diffusion of the light far from satisfactory. But this year has seen the introduction of a diffusion globe which is based on an entirely different principle, and which, with our present tendency towards small centers of high intensity, becomes simply invaluable. These globes, designed by Blondel and Psaroudaki, and lately introduced under the name of "Holophane" globes, give us the power not only of correcting the irregular distribution of light from the mantle, and bringing the maxima of rays down to the working angles, but also make the surface of the globe the light distributing medium. In order to do this the globe is constructed of clear glass, so moulded that the exterior consists of horizontal lines of prismatic form running round the globe, while the interior is covered by vertical lines of prisms running from the top to the bottom. If the globe only had the horizontal prisms around it, the source of light in the center of the globe would appear as a vertical band of light, as is seen in the Frédureau globe; while if the vertical prisms only were present, the light would be drawn into a horizontal band in the same plane as the mantle. But the combination of the two draws the light evenly over the whole surface of the globe. The horizontal prisms are so moulded as to deflect downwards the excess of light otherwise escaping upwards, and so give an increase in illuminating power over the working angles; while the large surface of emission makes the light pleasant instead of irritating to the eye. [Sample globes were shown.]

In order to ascertain how these globes compared with those most generally used with Welsbach burners, I made a long series of tests on the radial photometer as to the absolute gain or loss in direct illumination afforded by their use. In carrying out these experiments five observations were made with the unshaded mantle, then ten with the shade that was under trial, and immediately after five more with the unshaded burner. So that for each globe a separate set of ten observations with the unshaded as well as with the shaded light were obtained, and the percentage loss or gain was calculated from the average of the results. Observations having in this way been made for the angles below the horizontal, the results indicate the absolute gain or loss due to the shade or globe at that angle. It would be unnecessary, and indeed confusing, to give the enormous mass of figures obtained in this way. The following table furnishes a summary of the mean loss or gain in light due to the globes used at angles between the horizontal and 45° below it:

Kind of Globe.	Percentage Gain or Loss in Light.
Holophane, tulip shape	gain of 12.3 per cent.
" conical	" 13.1 "
" conical pink.....	" 1.1 "
White opal.....	loss of 2.5 "

Ground glass	loss of	12.4 per cent.
Frosted glass, tulip shape	"	11.2 "
" " pink	"	23.2 "
Pink opal	"	34.1 "

These results not only show the great gain with "Holophane" globes, but also bring out in the clearest possible way the serious loss of light involved by the use of pink-tinted globes and shades.

It must not be supposed that these figures impute to "Holophane" globes a power of creating light. If the light emitted in every direction were taken, a small total loss would be found, due to the absorption of some light by the glass; but the angles at which the upper prisms are set deflect downward some of the rays which otherwise would be expended on the cornices. The more uniform distribution of light taking place from a far larger surface than the original source, does away with sharp shadows and the glaring contrast between the source of high intensity and the objects illuminated by it. Interesting experiments have been made by several observers which seem to show that, if the diffused light thrown by opal and ground glass shades be measured, as well as the direct illumination, the loss of light due to them is not so great as was at one time supposed. Stort deduces from his experiments the fact that clear glass globes cut off 6 per cent. of the total light, while "flash-coated" globes are responsible for a loss of 11 per cent.—figures which agree very well with those I have put forward. In other words, in order to gain any true idea of illuminating effect, it is necessary to take the light emitted over all the working angles, and not on the horizontal plane.

The illumination of outdoor spaces and roadways calls for very different treatment to the lighting of the interior of houses. In this form of lighting there is no reflection from the ceiling to help the feebleness of the downward radiation, and reflectors become almost a necessity. It is in exterior illumination that incandescent mantles find their true application, and anyone who has seen the magnificent effect produced by their grouping in the Champs Elysees in Paris, and the way in which they entirely dwarf the electric light installations in their immediate neighborhood, must feel that, both in economy and effect, they are the best outdor illuminant that can be obtained; and with the standards placed at sufficiently close intervals to prevent zones of darkness between them, they leave little to be desired. Even here, however, one finds circumstances under which the color of the light emitted by the Welsbach mantle is a drawback. Observation shows us that, as long as the atmosphere is sufficiently clear to enable us to see the sun or the moon apparently white, but little difference can be noticed in the penetrating power of our outdoor illuminants. But as soon as either of these luminaries begins to show a yellow or reddish tint we immediately begin to notice that the arc light or the Welsbach incandescent mantle begins to fade far more rapidly than the ordinary gas lights; and that, even in the thickest fog, the gas lamp, the oil lamp, and even the candle seem able to battle more successfully with the atmospheric conditions than their more pretentious rivals. This is perfectly clear to the eye; but, as far as I know, no attempt has been made to ascertain the ratio of the percentage of light so absorbed among the ordinary illuminants themselves, though Professor Tyndall's work on lighthouse illuminants shows clearly the differences which exist in this respect between the electric light and the light due to gaseous flames.

The explanation of the yellowish-red appearance seen during a fog is that it is caused by the filtration of the light rays through the minute particles of which the fog largely consists; and the same effect is produced when the sun is seen through smoke. The colors in the spectrum are the result of variations in the wave lengths—the difference from crest to crest of the red rays being large as compared with the wave lengths which give the blue and violet end; and the gradual decrease in the distance between the crests is found to take place from the red down to the ultra violet rays. When the bundle of mixed rays which we call white light come to penetrate the finely divided mass of particles, the small and rapid waves of the blue and violet become checked and absorbed, while the waves of greater amplitude are able to find their way through the obstructions, the result being that the light which reaches the eye, being bereft of a large proportion, at any rate, of the blue and violet rays, has a preponderance of the light from the other end of the spectrum, and therefore appears red or orange in color according to the thickness of the obstruction through which it has passed.

A very beautiful way of showing this is to cause the horizontal rays from an electric lantern to pass through a cell containing a dilute solution of sodium hyposulphite, when a white disc is formed on the screen. On adding some hydrochloric acid to the hyposulphite, a gradual separation of particles of sulphur takes place, and forms a cloud in the liquid. As this behaves in the same way as the solid particles suspended in the fog, the disc of white light is seen to go through the changes of color so familiar to Londoners during the fall of the year. [This was shown on the screen.] I have attempted to utilize a modification of this experiment in order to determine the power of penetrating fog which illuminants possess; and to do so I have constructed a glass cell 18 inches square and 3 inches from front to back. It was filled with a solution containing 0.1075 gramme of sodium hyposulphite to the liter. The illuminating power of the light source to be tested was first read on a photometer in the ordinary way; then the cell containing the clear liquid was interposed half way between the light and the screen, and a second reading was taken; the difference between the two giving the light cut off by the cell and the liquid contained in it. Then there was added 0.05 gramme of hydrochloric acid per liter, and the solution was allowed to stand until the fine haze of sulphur particles which separated from the hyposulphite had finished forming. Experiments showed that this took some time, but that, owing to the extremely fine state of division of the particles, the haze, when once produced, would remain constant over a long period. When the haze had completely formed, another reading was taken, and from the three figures thus obtained it was possible to deduce the amount of light absorption due to the haze in the liquid, apart from the absorption of the cell and the liquid which it contained. [Experiment performed.]

Working in this way with the greatest possible care, it was found that considerably less light was absorbed from the yellow coal gas flame than from the whiter acetylene flame; while the absorption of the greenish-blue light of the Welsbach mantle was very great indeed, as shown by the following table:

Coal gas flame	11.1
Acetylene flame	14.7
Welsbach mantle	20.8

This means that the acetylene suffers to the extent of 32 per cent., and the Welsbach burner loses 87.3 per cent. more of its light-giving power than our old friend the gas flame.

In all methods for obtaining light, the great test for the efficiency of the process is, after all, the percentage of the energy employed which is transformed into light; and we find that the amount so utilized, as compared with the production of heat, is extremely small in all artificial illuminants. This is shown by the following table:

	Heat.	Light.
Candles	98	2
Oil lamps	98	2
Coal gas—		
Flat-flame and Argand burners	98	2
Regenerative Argand burners	94	6
Incandescent Argand burners	88	12
Electric light—		
Geissler tubes	97	3
Arc	90	10
Incandescent	95	5
Magnesium light	85	15
Sunlight	70	30
Glow-worms, fireflies and luminous beetles	1	99

It is therefore evident that, great as has been the advance made by the incandescent mantle over all other methods of consuming coal gas, there is still an immense field open for further improvements; and the present incandescent mantles might be easily surpassed in their power of light-emissivity.

A Colorado Coal Washer.

The Colorado Fuel and Iron Company recently built a coal washing plant at its mines, near Sopris, in Los Animas county, Col., which is giving excellent results. At this plant the coal is taken from under the main screen at the tipple by a Jeffrey conveyer composed of No. 518 steel link chain with attachments every 32 inches, carrying steel scrapers 18x10x3-16 inches with cross bars, axles, and rollers. This conveyer is 260 feet long, and elevates coal a vertical distance of 83 feet, on an angle of 18° 40′ from the horizontal. It has a capacity of 700 to 800 tons in 10 hours of coal that will fall through screen spaces 4½ inches, 6 inches between diameter bars. The coal, just before discharging at head of elevator, passes over screen bars set 1½ inch apart in the bottom of the conveyer trough, which takes out most of the slack and small coal. This goes direct to a pair of sizing screens, while that which passes over the conveyer screen, including all the large pieces,

falls into a Jeffrey coal crusher with teeth set in movable rings. The product of the rolls joins the fine material from the conveyer, and falls into sizing screens 18 feet long by 6 feet diameter, covered with perfo rated steel plates, which have for one half their length ½-inch square holes, and for the other half, 1½-inch square holes.

Coal passing over the screens is called nut; coal through 1½ inch square holes, pea; while that through the ½-inch square holes is a mixture of dust and buckwheat. The nut and pea are collected in bins direct, while the finest material is allowed to fall past the mouth of an air-blast pipe, which blows away the dust, the cleaned buckwheat falling into its proper bin.

From the bins the different sized coals pass to washing machines or jigs, in which the slate, bone, sulphur, and other impurities are removed, while the washed coal is carried by water to the cross-conveyers. These are so arranged that one conveyer handles buckwheat, another pea, and the third nut. The dust taken out by the blower mentioned above does not pass into the washing machines, but is sent into the larry-bin without washing.

The cross conveyers are arranged to carry coal to the center of the washer room, the upper flights carrying from one side, the lower flights from the other, and each section is provided for 9 feet of its length with a perforated bottom, through which the water drains off while the coal is moving along. These conveyers are 30 feet center to center of sprocket wheels, and consist of two strands of No. 504 steel link chain with swivel attachments with oakwood flights, 6 x 12 inches, two inches thick. They are driven direct from a line shaft overhead with Jeffrey detached link belt, the shaft making 80 revolutions per minute to 22½ revolutions of the sprockets, or conveyer shafts. The coal is drained thoroughly, and no water remains except that naturally clinging to it.

The central conveyer runs from end to end of the main building, and is 36 feet long, center to center of sprockets. It is composed of No. 516 steel-link chain with attachments 24 inches apart, carrying plates 18x6x3-16 inch, with a No. 10 steel trough. It runs about 200 feet per minute, and has sufficient capacity to carry all the washed coal to the disintegrator at one end of the building.

From the disintegrator the coal is carried to the larry bin in the bucket elevator. This is very slightly inclined, and is 61 feet 4 inches center to center of sprockets. It is composed of No. 518 steel link chain, with attachments every 32 inches, in two sections, right and left, with centrally hung buckets 24 x 12 x 10 inches of No. 10 steel, with re-enforced front lip. It carries the disintegrated coal at a speed of about 245 feet per minute. This coal is quite fine, and is damp enough to be very sticky, so that a high speed of discharge is essential, otherwise a slower speed would be more economical as regards wear and tear of machinery.

All driving belts, except those of the centrifugal pump, the blower, and the crusher, are of Jeffrey roller chain. The engine furnishing the power is one which was already on hand, and, in order to utilize it and bring the speed of chains down to a safe limit, a counter shaft was interposed. From this a steel thimble roller chain, conveying 90-horse power, drives a line shaft in the center, from which the belts to the jigs and the washed coal conveyers are taken.

Strength-Testing Machines.

The Boston *Transcript* says that one of the most interesting places in the city of Boston to one of a mechanical turn of mind is the engineering building of the Massachusetts Institute of Technology, and especially that part of it where the tests of the strength of different materials are made. The testing plant is one of the best of its kind in the country, and the test of the strength of about anything, from twine to iron columns, can be made. It is not generally known, but it is a fact that it was at this plant that the fire tests of large beams, columns, etc., for buildings were made, and as a result of the discoveries which were made by these tests the building laws all over the world were changed.

The most interesting discoveries were made with regard to the strength of wooden beams. Previous to these tests the strength of beams had been figured by testing small pieces of the same kind of wood and then calculating the strength of the beam from the strength shown by these small sections. In making these calculations the small pieces which were tested were taken perfectly clear and free of knots, and allowance was made for the weakening of the beams by the imperfections in them. As a result of the tests made at the Institute on entire beams it was shown that this allowance was not nearly large enough, and that for some time beams had been figured on to carry loads which would bring them dangerously near their breaking point.

The most imposing figure in the testing plant at present is the big machine which is used for crushing and tensile tests. The machine is an Emery patent, and is on just the same principle as the one at the Watertown arsenal, although it is not so powerful, the latter being the biggest in the world. The Institute's machine has a strength of only 300,000 pounds, but this is enough for any tests which are made there, and in fact for the large majority of the tests which are made at the arsenal. This machine will crush a great iron column together endwise in its powerful grasp, or will pull it apart as a confectioner pulls molasses candy.

More spectacular than such tests as these are those made on wood beams, when the great timbers after resisting to their utmost bend upward and then break with a tremendous rending crash. The most dangerous tests are those made on blocks of stone, granite especially. A block of granite will resist almost to its breaking point without giving any sign, and when it goes, it goes with a report like a small cannon, and is reduced almost to powder. The small fragments fly with tremendous velocity, and it is neessary in making a test of this kind to cover the object with thick layers of cloth to prevent the wounding of the students.

Over in the corner of the basement is the torsion machine, one of the most interesting in the whole plant. It is powerful enough to twist a 3-inch bar of the finest wrought steel an unlimited number of times. It is surprising the extent to which a bar of good material will twist before breaking. There are at the Institute some bars of Norway iron which have been twisted round and round twenty times in a length of 6 feet, and the pitch is as even as though it had been cut with a machine. Domestic iron, on the contrary, will stand hardly any twist without breaking. The means by which the twist is measured is remarkably interesting. Two telescopes are mounted on the bar before the twisting process is begun, and these are sighted on a graduated scale on the wall across on the other side of the shop, and by this means the slightest movement of the bar can be read with the greatest distinctness. It seems almost incredible, but it is possible for a man to take hold of the bar when it has been clamped into the machine, and by twisting it with one hand to produce a movement which is discernible on the scale on the wall.

That Acetylene Explosion in Paris.

The *Gas World* says that the explosion of acetylene at M. Raoul Pictet's works in Paris gave rise to an animated discussion in the Paris Town Council at a recent meeting. M. Adrien Veber stated the alarm that had been caused to the inhabitants, and questioned the Prefect of Police categorically as to the conditions under which the works had been opened; as to whether M. Pictet had made use of any subterfuge in stating the purpose of his works; as to whether he had made the declaration required by law; as to whether the Prefect knew that M. Pictet was making acetylene; and as to why, if he knew this, he had not ordered the closing of the works as a works not classified. Further, he wanted to know what steps had been taken to reassure the public mind in reference to the future. In reply, the Prefect said that it seemed probable that the explosion was caused by a workman shutting the stock-cock too sharply, in order to check an escape; that the large gasholder, though it had not exploded, was directly in the path of the explosion, and was largely covered with the resulting deposit of carbon; that the gasholders were very securely fitted up; that M. Pictet had not made any false declaration, but had made no declaration at all; that he ought to have done so, not in reference to the cylinders, but in reference to the gasholder; that for this he was to be prosecuted before the police court; that the penalty could not be severe, but the condemnation would have the more remote effect of subjecting M. Pictet to a sentence by the Correctional Police, and of making him liable for damages in a civil court. He added that M. Pictet began about two years ago what he called an experimental institute; that this was not subject to supervision; that it was alleged that the work done there was the liquefaction of nitrous oxide and carbonic acid; that no intimation was given as to any change, and the police had no right to enter and inquire. He further said that the two gasholders had been emptied the day after the explosion, under police orders, and the thirty or forty cylinders of liquid acetylene had been sent out of France by M. Pictet. The question of classification and supervision of acetylene works was under official consideration, and the report of the Government Ministerial-Committee was expected in a few days. If it be decided that acetylene works are dangerous, Class I., the manufacture

will be totally prohibited within Paris. At present, no one can have more than 350 cubic feet of acetylene gas on the premises. After this statement there was a continuance of the discussion, in which the endothermic nature of acetylene and the circumstances which may give rise to its explosion came under review, and the police authorities were severely criticised for not knowing more about where the acetylene used in Paris came from. Attention was also drawn to the danger incident on carrying about the numerous liquefied acetylene cylinders now to be seen in the streets of Paris.

The causes of the explosion are still to seek. It was at first thought that a light might have been brought near a cylinder still containing a remainder of liquefied acetylene. M. Vieille, however, has ascertained that this could not be the case, for no such small remainder would produce so fierce an explosion and do so much mischief. The remains of the cylinder were found all over the place, and from its number it was ascertained that it had been sent to Brussels full and returned nominally empty, along with seventy-four others. The blackening produced by the explosion was so widely spread that the cylinder must have come back full, or nearly so, that is, with nearly eight pounds of liquefied acetylene in it. Then the two workmen who were killed on the spot were set to their usual task of cautiously opening the stop-cock of each cylinder to let out the gas, as a preliminary to any soldering or repairs which might be needed; and it appears that the accident took place when they were engaged in this. If the explosion were not due to the flame of a lamp, there seem to be two possible explanations. First, that the workman opened the stock-cock too sharply and produced a rush of gas which heated the nozzle and set up an explosion; and second, that the plug of the cylinder was of copper, and, as sal ammoniac had been used to lute the plug, that acetylide of copper, an explosive substance, had been formed on the cylinder and exploded on the workman's trying to open the cylinder, and thus set the acetylene off; for acetylene at pressures above two atmospheres is now well ascertained to be an explosive substance which can be set off with a cap, though at ordinary pressures no such effect is produced. The effect of such explosion, as Messrs. Berthelot and Vieille have shown, is a complete break up into carbon and pure hydrogen. M. Girard and M. Vieille are engaged in experimenting on the subject, for the police magistrates.

Swindell's Improved Gas Producer.

On December 1st United States Letters Patent (No. 572,184) were granted to Mr. James D. Swindell, of Pittsburgh, Pa., for certain improvements in gas producers. Using the words of the specification :

My invention relates to an improvement in gas producers, and it consists in certain novel features of construction and combinations and arrangements of parts, as hereinafter set forth and pointed out in the claims.

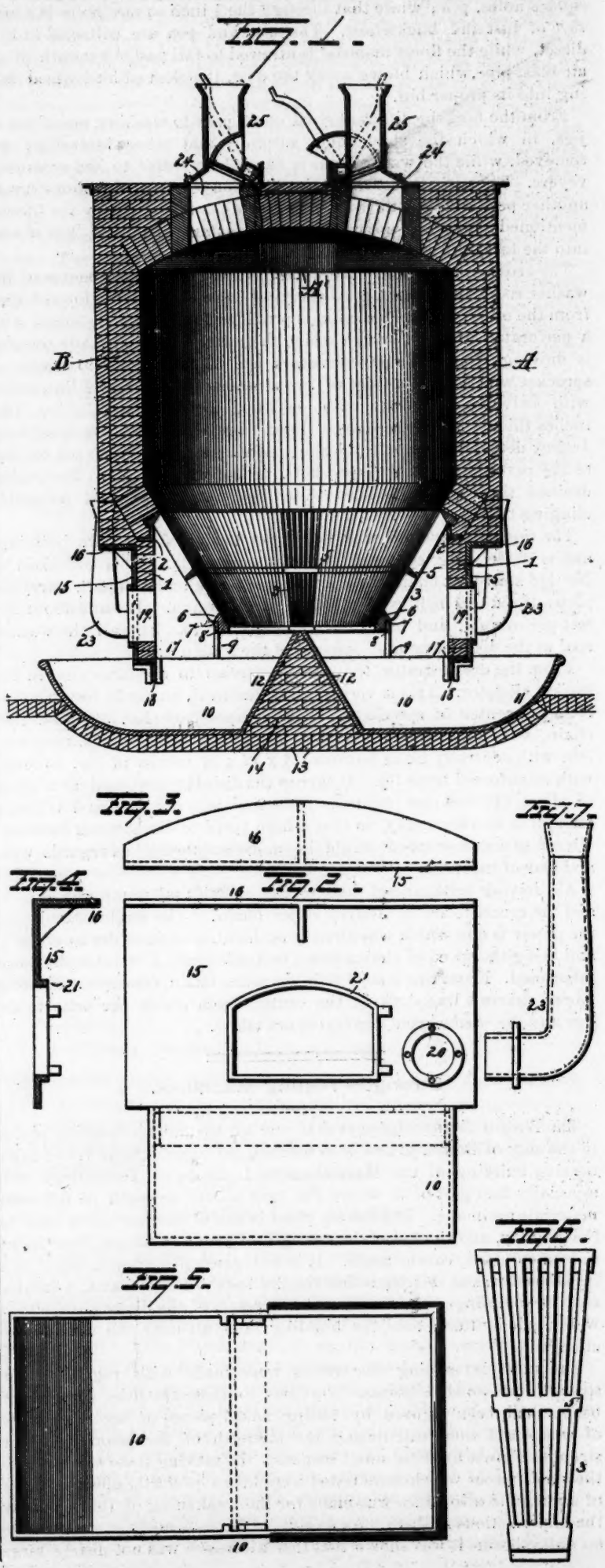
In the accompanying drawings, Figure 1 is a vertical cross-sectional view of a gas producer embodying my improvements. Figs. 2, 3, 4, 5, 6 and 7 are detail views.

The body of my improved gas producer comprises a wrought iron shell *A* and a lining *B*, of firebrick, the latter being arched at the top and having a gas outlet A^1.

The lower portion of the apparatus is made with an annular lining 1, on the top of which a ring 2 (L-shaped in cross section) rests.

Within the space formed by the annular lining 1 a circular basket grate 3 is disposed. The basket grate 3 is made in the form of an inverted truncated cone, and at its upper or larger end is provided with an outwardly projecting flange or shoulder which normally rests on the ring 2, thus in effect suspending the basket grate from said ring. The grate is provided between its ends with strengthening ribs 5, and at its lower or smaller end with a ring 6, having a recess 7 for the reception of an iron band 8, and the latter is supported by means of a series of posts 9. The posts 9 are attached at their lower ends to a basin 10, disposed under the body of the apparatus. The basin 10 is made of a length to project beyond the ends of the body of the producer and the ends of said basin are preferably curved or dished, as shown at 11, Fig. 1. In the center of the basin 10 there is an upward projection 12, made A-shaped in cross section, and the apex of said upward projection terminates at the bottom of the grate at the center thereof. The basin 10 rests on masonry 13, the central portion 14 of which projects within and fills the A-shaped projection 12.

The ends of the lower portion of the producer are provided with face plates 15, which rest against the lining 1 and have outwardly projecting flanges 16, disposed under the lower ends of the main wall of the producer. Under the lining 1 angle irons 17 are placed and supported at their ends by the basin 10, the depending flanges 18 of said angle irons preferably dipping in water contained in said basin. Each face plate is made with two openings 19, 20, the openings 19 being normally closed by doors 21, and the openings 20 being for the accommodation of the blowpipes 23, the inlets of said blowpipes to the producer being thus disposed about in line with the bottom of the grate.



The top of the producer is made with openings 24 for the admission of coal, the supply of which can be controlled by suitable feeding hoppers 25.

When the coal enters the producer it has room enough to expand and allow the gas to be forced from it from all sides. As the gas is taken from the coal the latter will be contracted and reduced and enters the basket-shaped grate in the form of coke, which produces a hot fire, which forces the gas from the coal. The residue, consisting of ashes, partly burned coke, clinkers, etc., will be divided by the A-shaped projection 12 and made to enter the water bath, from which said residue can be easily and quickly removed.

The A-shaped projection 12 in the basin 10 above referred to can be conveniently formed by making the basin in two sections and making the adjacent ends of said sections inclined.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is—

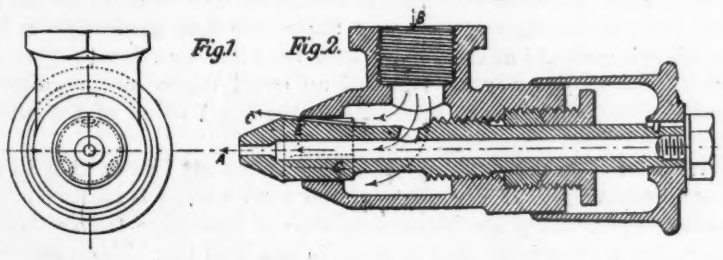
1. In a gas producer the combination with a body portion for the reception of coal, of a basket grate, and a projection having steep sloping sides and a sharp pointed apex, the apex thereof reaching across the center of the grate from side to side thereof, and serving to divide the falling ashes and cause them to descend in two directions as they drop from the grate, substantially as set forth.

2. The combination with a body portion, of a basket grate, a basin, and a projection extending upwardly from the bottom of the basin with steep sides, its apex reaching beneath the center of the grate, substantially as set forth.

3. The combination with a solid masonry wall, and an annular ring L-shaped in cross section built therein, of a basket grate, the upper end of which hooks over the ring and is built into the masonry wall, substantially as set forth.

Granger's Jet Nozzle.

The illustrations show in detail an air-jet nozzle recently introduced to the European market by Mr. W. A. Granger, of 102 Brooke road, London. It is specially suited for use in injecting air over a boiler furnace, and for other purposes, the special feature being the ease with which the volume of air issuing may be regulated at will. The steam enters at *B*, and passes as shown by the arrows to the center jet *A*, and



to the jets *C*, of which there are three made in the form of a flute or groove cut in the plug *E*. These flutes deepen and widen as they extend toward the right hand, so that the jet becomes larger in area as the plug is moved forward. This forward movement is brought about by the turning of the milled sleeve at the other end, and the extent of the opening is shown by gauge markings on the surface uncovered by the turning of the sleeve. When worked with 60 pounds steam and in a 5-inch pipe the pressure of the air current may be increased from ¼ inch to 2 inches, according to water gauge, and on a 4½-inch pipe up to 2½ inches. They are manufactured in many sizes.

Screening and Tipping Coal.

At an ordinary meeting of the Institution of Civil Engineers, (London, December 8), Mr. James Rigg read a communication on "Screening and Tipping Coal", which embodied an account of the various forms of screening and tipping machinery employed in recent practice. Greater importance was now placed upon the preservation of coal from damage in loading, screening, and in transit than formerly, on account of the keener competition in the supply of coal for domestic purposes. The rate of increase in the amount of coal raised in the United Kingdom for manufacturing purposes had greatly exceeded that for domestic use, so that the supply of coal per head of the population was now more than double its amount 33 years ago, while the population had barely increased 50 per cent.

The leading types of trams and corves, as influencing the methods of tipping, were illustrated and described. It was pointed out that end doors caused the weakened sides of trams so constructed to involve a permanent and continual expense for repairs, and, having regard to all questions to be considered, including accidents and occasional collisions, the "box" tram, with timber sides and steel or iron floors, was advocated.

Illustrations were shown of the various methods of tipping, also the method of delivering from open-ended corves without the adoption of a tip; and various forms of tipplers, oscillating as well as revolving both forwards and backwards, with and without the assistance or control of counterbalance weights and brakes, were described. Diagrams were likewise exhibited to prove that the fall of coal from side-tipped corves was greater than that from corves tipped endwise, and that the arrangements often made by colliery proprietors, at inconvenience and expense, to bring on the coal from the former direction were consequently not productive of the economy believed to result. It was contended that the tipping of open-ended trams caused the largest and most valuable coal, forming the top of the load, to leave first, and sustain severe shock and breakage on the screen, and that it consequently was not protected by the lower coal.

With a view to obviate the objections to these tipplers, the author had designed a tipping machine, which he showed in four positions of its oscillation. It was counterbalanced and under control of a brake, and the coal was received upon a plate at right angles to the floor of the corve or tub, and checked by a light balanced door. The fall, common in various degress to all the other forms of tips, was thus entirely prevented. The application of this tipping machine for the loading of coal from end-door railway wagons of 4 ft. 8 in., as well as metre, gauge, was also illustrated.

For screening and separating coal, the revolving or barrel screen was first described. Though effective in separating the sizes, and well adapted for use in conjunction with brick-making machinery, and for screening minerals which were not deteriorated by the process, it was so destructive to the coal as to be quite unsuitable to that intended for domestic use. In a less degree vibrating riddles caused similar injury, and involved the expense of the power needful to drive them. An illustration was also given of what was considered one of the best forms of picking belt, with screens, and loaded by revolving side tips; and the author contended that, inasmuch as the travel of this belt was definite, and the quality of the coal, as regarded need for picking, varied widely, a much larger number of pickers must be employed to secure the best results than was needful for the average work, and consequently unnecessary expense was incurred.

The sections of the leading types of screen bars were examined and the objections to those with round and particularly diamond-shaped heads pointed out; it was shown that by setting light flat topped steel bars in ranges of short lengths, alternating bars and spaces in each range, the slack was effectually entrapped in the upper end of the screen hopper without any other aid than the force of gravity. The pitch between these bars could also readily be changed to suit the varying demands in different seasons. Descriptions were also given of fixed screens, suitable for special purposes, and of a curved balanced screen worked under the control of a brake, and, for loads of 16 cwt. and upwards, under that of a cataract cylinder. The coal distributed itself over the lower end of this screen and could be readily sorted. Whether much or little labor was involved in this process, the number of pickers was small, because the operator had complete control over it, and on release of the brake or cataract its weight caused it to descend gently to the angle of delivery, an automatic latch preventing the actual passage of the coal into the truck until the screen attained the correct angle of delivery to secure the minimum of fall at this point. The most effectual and economical methods of tipping and screening or separating coal were those employing the force of gravity only.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, December 10th, 1896.

The Sulphate Market—Mr. Newbigging on the Parliamentary Valuation of Gas—The Theory of the Incandescent Gas Burner.

Sulphate of ammonia has lately come in for a share of attention on account of the phenomenally low prices to which it has fallen, together with the fact that no sufficient explanation is forthcoming, to account for such a marked depreciation in value. The chief cause of this state of things appears to be that it is "nobody's child." Gas engineers have their time so much occupied with the numerous details incidental to the main features of their business that they cannot do more than

sell off the sulphate for what it will fetch. An attempt was made some years ago to form a "Sulphate Producers' Association," but it has only led a very dwarfed and feeble existance, owing to lack of anything like general support. So it is nobody's business to look after the interests of the sellers, while on the other hand there are active combinations amongst merchants and dealers in this article, and the proprietors of the only other source of nitrogen available for agriculturists—nitrate of soda—are actively pushing its sale by every possible means. They encourage experiments, circulate information and offer prizes for produce raised with the aid of nitrate, and at the same time take care of their own interests in the matter of price, and the result of their efforts, as shown by the published statistics as to prices as compared with those of sulphate, quantity sold, etc., are very instructive. The President of the Gas Institute, in referring to this topic in the course of his presidential address delivered last June, said that the fall in values had been entirely brought about by the speculative dealers, who took advantage of the weakness and utter absence of united action amongst producers, to sell forward at low prices, and they were greatly assisted in this by the readiness with which some producers could be induced to sell in advance. The speculator held the market. This course was injurious to the interests of the trade, the popularization of sulphate as a fertilizer, and to the maintenance of steady prices; and it could be met by refusing to sell forward, not accumulating large stocks, and cultivating a direct trade with the farmer or the manure merchant. Mr. W. E. Price made an elaborate examination of the market during the last four years, in the course of a paper read a few weeks ago before the Southern District Association of Gas Managers. His tables show that whereas, during 1893 and 1894, sulphate was selling at 30 per cent. or so more than nitrate, the prices have gradually approached in 1895 and 1896, and at the present time nitrate is actually selling for more than sulphate. He showed that while the production of sulphate had steadily increased, the consumption both at home and abroad had decreased. If better prices were to be obtained something must be done to increase the demand. He also showed that stocks had been allowed to accumulate in the hope of better prices, and suggested that the market should be relieved by disposing of these stocks to local farmers at cheap rates. The present depression would thus be improved, and at the same time many would become acquainted with the valuable manurial properties of sulphate.

At the meeting of the Manchester District Institution of Gas Engineers, held a few days since, Mr. I. N. Kitson, formerly of Jersey, but now of Kendal, who is well known as the author of a pamphlet on "Sulphate of Ammonia as a Manure," contributed some "Notes on Sulphate," in the course of which he attacked the question in masterly style. There is no doubt but that if his advice is taken upon an adequate scale, marked benefits will immediately follow. He wants to see combined action amongst producers for the purpose of encouraging systematic experiments, so as to obtain practical trustworthy results for publication. As to over production, he goes to the agricultural returns and shows that, taking the acreage under cultivation in the United Kingdom, the present production of sulphate would only suffice to give a very moderate dressing to about one-third of that area. Taking wheat, barley and oats alone, the weight of nitrogen taken from the land in a year, is equal to about twice the present production of sulphate. He also argued that sulphate was not losing favor on the Continent, though of course there would be fluctuations in the demand. Mr. Kitson is able to speak from actual experience, as he was very successful in creating a home demand for sulphate at Jersey, and he claims that sulphate not only contains a higher percentage of nitrogen, but it is free from the objectionable deliquescent properties of nitrate, and can therefore be used for the preparation of mixed manures that may be stored for a time before using. He considers that the objects indicated in his paper could be accomplished by a levy of about 1s. per ton of sulphate made, or a total sum of £10,000, and that the results would be increased receipts to the tune of £300,000 or £400,000. There appears to be a general agreement that sulphate is now selling badly, that it does not realize anything like its proper intrinsic value, and that the remedy is to a large extent in the producers' hands.

Mr. Thomas Newbigging has been looking through the annual Parliamentary returns of gas undertakings, and has made the subject of illuminating power, as reported therein, the theme of some very trite observations, in the form of a paper read before the recent meeting of the Manchester Distrtct Institution of Gas Engineers.[1] Every statutory undertaking has a prescribed minimum illuminating power, which ranges from 10 to 20 candles; but out of a total of 574, no less than 519, or 90 per cent., came between 14 and 16 candles. In order to keep squarely over the line, it is usual to work at a somewhat higher figure, say a candle or a candle and a half higher than the standard, but Mr. Newbigging remarks that many of the undertakings go considerably farther than this, and send out gas 2, 3 or 4 candles in excess of the standard. So that in some instances the consumer gets 20 per cent. more than he bargains for, and on the whole he calculates that the English gas consumer gets about 60 million thousands cubic feet of gas more than he pays for, after allowing an additional candle beyond the standard rate in the form of extra quality. He observes that the whole question of illuminating power is in a chaotic state, and that remarkable variations occur even in neighboring towns. His figures assume that the returned illuminating power is really a correct average of that actually supplied, and that the illuminating power is a fair representation of the commercial value. On the first head it should be remarked that much of the variation in the returns is due to the way in which they are prepared. To begin with, there are several kinds of photometers and of standard burners used. Some companies, who obtained their powers 30 or 40 years ago, still continue to retain the burner then prescribed, which is known to show 2 or more candles less than the modern standard burner. From this cause alone it happens that an old company returned at 15 may be actually supplying a better gas than a modern company returned at 16. Then in some cases the return is based on the municipal examiners' tests and in others on the suppliers'. Sometimes the tests are taken at the works, and sometimes a mile away. Some officials think it necessary to carefully average up the tests during the year and to state the result up to the second figure in decimals, while others consider a good round estimate sufficient. The truth of this is shown by the fact that many of the returns are stated in even candles. A figure of "15" or "17" candles is more likely to be an approximate estimate than an average of tests. So I do not think the actual difference, particularly in neighboring towns, where it often happens that similar kinds of coal are used, is really so great as it figures in the returns. But it would be well if a greater degree of uniformity could be observed in the preparation of the same. There is, however, after every allowance, something very peculiar about this question of illuminating power. Some of the districts actually overlap, so that one side of a street may be supplied with Parliamentary 18-candle gas, and the other with 15. But the public do not notice the difference, and if asked to pay a *pro rata* price for the superior article would probably deny that it was better than the other. They would rather say that all gas is bad alike. Such want of uniformity in official returns cannot but have a bad effect in the way of bringing the whole into disrepute. If Mr. Newbigging should at any future time treat the question of "selling price" in a similar way, he will find an equal degree of irregularity, and that entirely without reference to the legal value of the article supplied.

We have it on the authority of Prof. Vivian B. Lewes, that in the incandescent light, 12 per cent. of the total energy is realized in the form of light, which is a better duty than is attainable from either of the forms of electric lighting that are in practical use. Regarded from a scientific point of view it is interesting to speculate as to why this new form of burner should show such a large improvement on other gas burners. Even with the aid of regeneration it is only possible to obtain about one-half of this duty by means of an unimpeded flame, so why should the introduction of a "mantle" which remains unaltered in composition practically double the production of light? Another interesting reflection is that the larger production of light means a proportionably less production of heat, and this has been experimentally proved in Germany. Some experiments were tried with a naked burner, a thorium mantle (which gives a low lighting effect), and a mantle equal to the Welsbach, and the heating effect was found to be in inverse proportion. Applying this calculation to equal illuminating values, the results are remarkable. An ordinary flat flame burner gives a duty of about 3 candles per cubic foot per hour, so to give a light of 60 candles for one hour, 20 cubic feet of gas must be used. Reckoning the heat producing capacity of the gas at 620 units per foot we have a production of 12,400 units. Of this only 2 per cent., or 248 units, is converted into light, leaving about 11,500 units wasted in the form of heat. The incandescent burner will give a similar lighting effect, with 3½ cubic feet of gas, which at 620 per foot means 2,170 heat units. Of these 12 per cent., or 260 units, disappear as light, leaving only 1,840 units wasted in the form of heat. Light for light, there is less than one-sixth the amount of heat produced by the incandescent gas light, and the proportion of oxygen consumed, with a corresponding production of water and carbonic acid, is under one-fifth. Whether the practical value of one incandescent light is equal to that of four good flat flame burners is another question with which we are not now

1. See JOURNAL, p. 972.

concerned. But the point is—What is the action that makes, not two blades of grass grow where only one grew before, but six times the practical value? It has been occupying much attention amongst scientists lately. Some have supposed that chemical action is concerned, and others ascribe it to physical causes only, such as catalytic action. It is rather difficult to see how chemical action could go on for 700 or 800 hours, on a few grains weight of oxides, without producing some notable change. An article by Dr. C. Killing, which appears in a recent number of the *Journal fur Gasbeleuchtung* is an interesting contribution to the subject. The author quotes experiments to show that the high-emitting power of the Welsbach mantle is not due to intimate mixing of the oxides. A thoria mantle, consisting of thorium oxide only, gives very little light. But if coated with ceria by immersion in a weak solution of cerium nitrate, the lighting effect is as good as if the ingredients had been intimately mixed before immersion. One-quarter per cent. only of urania added to the thoria gave an excellent mantle, but when the proportion was increased to 1 per cent. the mantle was valueless. Only one twenty-fifth per cent. of platina increased the light-giving power of a thoria mantle some tenfold. A mantle made of one-half per cent. of iridia and the remainder of thoria, gave a still better effect. So the author arrives at two necessary ingredients in an incandescent mantle. The first is a non-volatile, and inert frame material, which need not necessarily be thoria. And the second a catalytic agent which must consist of a base that forms more than one oxide. Several metals meet this requirement, but they are more or less volatile at high temperatures, with the result that they are only transient in their effect, and in a few minutes the light dwindles till only the feeble thoria glow remains. The catalytic agent in the "Welsbach" mantle is ceria, and only minerals containing that base are of any value for the manufacture of mantles. The practical value of thoria as a basis is due to its high atomic weight and low specific heat, and to the fact that it leaves a very large surface after incineration. The catalytic or oxygen carrying property varies with the temperature in different basis, some being most active at high and others at low temperatures.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Paducah (Ky.) Gas Light Company have filed suit to enjoin the authorities from collecting taxes levied on account of assessment on the franchise under which the Company operates.

ACCORDING to the grant of the Akron (O.) Company, when the annual output reaches 40,000,000 cubic feet the selling price must be reduced to $1.25 per 1,000. The Company's business has been so prosperous this year that the authorities concluded to look over its accounts to determine whether or not the named sendout would be reached this season; but the result of the examination was to show that the sendout for the current twelvemonth would not exceed 37,000,000 cubic feet.

THE United Gas and Electric Company, to supply gas and electric lights in the districts of Dover, Rochester, Somersworth and Rollinsford, N. H., has been incorporated with a capital of $250,000.

MRS. ELIZABETH J. CAIN, of Atlanta, Ga., has instituted a suit for damages against the Atlanta Gas Company, basing her claim on rather odd premises. Some time ago the Company constructed a large holder on a site near the house occupied by herself and family, and prior to the construction of the holder she remonstrated with the builders, urging that the holder would cause her place of residence to become less suitable for her comfort, etc. The construction of the holder, she alleges, has proven the justice of her original claim, in that by it the sunlight is, for the greater part of the day, cut off from her home. Further, she alleges that the holder is an actual menace to her life and property, in that "it is liable to explode at any time!"

UNDER an amendment to the by-laws of the Brookline (Mass.) Gas Light Company, the office of Vice-President to the corporation has been arranged for.

THE Massachusetts Board of Gas and Electric Light Commissioners recently granted the Edison Electric Light Company, of Springfield, permission to issue $200,000 20-year 5 per cent. bonds. Of the issue, $90,000 will go to the construction and equipment of an auxiliary station at Indian Orchard, the balance to be used for funding a part of the floating debt.

"OBSERVER" forwards the following clipping from the Hartford (Conn.) *Telegram*, dated the 19th inst.: "It was announced yesterday that Harrison B. Freeman, Jr., as attorney for a syndicate of capitalists, will petition the next General Assembly for permission to locate and construct plants for the manufacture of gas and to lay pipes in the streets, highways and public grounds of Hartford, East Hartford, West Hartford, Newington, Berlin, Wethersfield, Bloomfield, Windsor, Southington, North Haven, East Haven, Brantford and Hamden, and to supply the inhabitants of the towns with gas for any and all purposes, subject to the consent and approval of the Selectmen of towns and municipal authorities of cities; also, to lay and extend pipe lines through the towns and cities of New Haven, Wallingford and Meriden."

AT the annual meeting of the Oneida (N. Y.) Gas Light Company a semi-annual dividend of 3 per cent. was declared payable on the 1st prox. The following officers were elected: Directors, S. H. Farnam, D. H. Walrath, H. S. Klock, John M. Kennedy and Walter E. Northrup; President, Walter E. Northrup; Secretary and Treasurer, H. S. Klock; Superintendent, Patrick Clark.

HENRY FISHER, B. R. Davis, B. F. Davis, John Flanigan and Wm. E. Lorch applied to-day, under the laws applicable, bearing date April 29th, 1874, to the Governor of Pennsylvania, for a charter for the "Freeland Gas Company," the "character and object" of the Company being the manufacture and sale of gas "for light only" in the borough of Freeland, Luzerne county, Pennsylvania, and its vicinity.

THE Pacific Gas, Light and Heat Company, of San Francisco, Cal., has applied to the Board of Trustees of San Rafael, Cal., for a franchise to construct works and to lay mains and pipes in the streets and alleys of the city for the purpose of distributing gas therethrough. The projectors assert that the maximum rate to be charged shall not exceed $2 per 1,000 cubic feet.

THE Hon. Reuben L. French, at one time President of the Pittsfield (N. H.) Gas Company, died at his home in Pittsfield about a fortnight ago. He was in his 78th year.

MR. PARKS FOSTER, of Elyria, O., has applied to the Council of Norwalk, O., for a franchise to construct and operate a gas works in that city. We understand that he proposes to purchase the gas mains and whatever other property the owners of the defunct concern that supplied natural gas in Norwalk have for sale.

THE Board of Aldermen of Richmond, Va., have agreed to the suggestion of the Committee on Retrenchment and Reform that the salary of the Superintendent of the city gas works be reduced from $3,600 to $2,750. The suggestion that the buggy and harness and horse formerly maintained by the city to assist the Superintendent in his work be sold was also indorsed. The Board, however, refused to cut the salary of the Chief Gas Inspector (Mr. Joseph M. Shelton) from $1,500 to $1,200 per annum, and the proposition to reduce the salary of the foreman of the lower works in the sum of $300 was also negatived.

THE following is the text of the resolutions adopted by the Board of Aldermen of this city in the instance of a proposition to determine whether or not it would be advisable to engage the city in the business of the manufacture and supply of gas on municipal account:

"*Whereas*, It is essential to the well being, health and comfort of the citizens of New York city, that each inhabitant should be afforded the opportunity to obtain the best and purest light and fuel at the lowest possible cost to the consumer; and

"*Whereas*, This necessity is on the same principle as, and only second in importance to, that which prompted the city to provide for every householder the purest, best and cheapest water furnished by any city in the world of equal population; and

"*Whereas*, The use of gas for illuminating purposes and for fuel and for use as a power in manufacturing and in the arts and sciences has largely increased, and with it has increased the necessity for the economical production of gas; and

"*Whereas*, The recent combination between the old Gas Companies and the new best illustrates the futility of expecting reductions in the price of gas from the establishment of competing Companies; and

"*Whereas*, This municipality has itself failed to secure cheap street lighting, because in advertising for competitive bids for that purpose it has been the invariable experience that there is not real competition, but that the different Companies apportion among themselves the different districts of the city, and offer non-competitive bids for the respective districts; and

"*Whereas*, The cities of Philadelphia, Pa.; Richmond, Va.; Wheeling, West Va.; Hamilton, Ohio; Birmingham, Leeds and Bradford,

England; and Aberdeen, Edinburgh and Glasgow, Scotland, have each become the owners of the gas plants situated in such respective cities, and a consequent reduction has thereby resulted to the consumers of gas in such cities,

"*Resolved*, That the President of this Board of Aldermen appoint a special committee of seven of its members to make a thorough investigation of the feasibility and practibility of municipal ownership of gas plants, the cost of manufacturing gas as now carried on by the existing companies, the price at which the city could deliver gas to the inhabitants thereof, should it become the owner of the gas plants, together with all other material facts in connection therewith that may be deemed necessary by said Committee to give information to the Mayor and Board of Aldermen of this city on the matter in question; and,

"*Resolved*, That said Committee cause to be prepared a bill to be presented to the Legislature of this State to carry out their recommendations in that behalf, and vigorously urge the passage of the same in the interest of the city and its inhabitants."

MR. JACOB LANG, Register and Chief Meter Inspector of the Bureau of Gas, Philadelphia, having resigned that position, it is intimated that his successor will be Mr. James McConnell.

THE Court of Appeals, of Washington, D. C., has granted a writ of error in the case of Thos. G. Lansden against the Washington Gas Light Company, which means that the United States Supreme Court will pass upon the questions involved.

THE real animus of the people interested in the fortunes of the Citizens Gas Company, of Bridgeport, Conn., which was chartered to supply fuel gas only, is shown by the following notice, issued at Bridgeport on the 15th inst., by Messrs. Hollister & Kelsey, attorneys for the Citizens Company:

"The petition of the Citizens Gas Company, of Bridgeport, State of Connecticut, a corporation chartered by the General Assembly of this State, respectfully requests of your honorable body that its charter may be amended, altered and enlarged, so that it shall be authorized and empowered to extend and lay its mains and pipes, with all the necessary and proper connections, in such of the streets, highways and public grounds of the the towns of Fairfield and Stratford respectively, subject to the consent and approval of the Selectmen of said towns respectively, as may be necessary and convenient to enable said Company to supply the inhabitants of said towns with the products of its manufacture and to sell the same to its customers present and prospective in the towns of Bridgeport, Fairfield and Stratford, in such quantities and for such uses and purposes as such customers may desire to purchase and use the same. Also, for the right and authority to connect the mains and pipes that it may lay in Fairfield and Stratford with its plant now in operation in Bridgeport; or to construct and build new plant or plants there for, either in Bridgeport, Fairfield or Stratford, as said Company may deem most convenient and advantageous for the prosecution of its business."

THE date set for the hearing of the application by the General Assembly of the State is January 7th, at the State House, Hartford.

THE negotiations between Mr. A. T. Badlam, of San Francisco, and the authorities of Ventura, Cal., for the establishment there of a gas plant, have not been completed.

MR. M. C. OSBORN has accepted the position of General Manager to the San Diego (Cal.) Gas and Electric Light Company. His successor at Santa, Cruz, Cal., is Mr. R. L. Cardiff.

A CORRESPONDENT at San Francisco forwards the following: "The articles incorporating the San Francisco Gas and Electric Company were filed on the 10th inst. The capital stock is $20,000,000, of which $13,816,000 has been issued. Of this amount $10,000,000 goes to the San Francisco Gas Company's shareholders, $2,750,000 to the shareholders of the Edison Light and Power Company, and $1,066,000 is held to redeem the $800,000 bonded indebtedness of the last-named corporation and pay interest on the bonds as the same falls due. The balance of stock ($6,184,000) is held as a treasury reserve. The offices will be in the new building of the Gas Company, on Post street, between Powell and Mason streets. The Directors are: J. B. Crockett, Adam Grant, Levi Strauss, George W. Prescott, J. Downey Harvey, D. T. Murphy, A. H. Payson, James B. Stetson, Charles E. Green, W. F. Whittier and P. J. Donahue.

THE Windson (Vt.) Gas Light Company has been adding to its main system.

THE New Jersey Heat and Power Company, formed to exploit the gas making process of Levi Stevens, of Trenton, N. J., has elected the following Directors: J. W. Place, Fremont Wilson and A. E. Walter, of New York city, and Levi Stevens, Sr., E. V. Richards and W. Holt Apgar, of Trenton.

THE Common Council, of Yonkers, N. Y., is still struggling with the franchise application of the Citizens Fuel Gas Company. Lawson N. Fuller is one of the active promoters of the scheme.

LAST August, Mr. John MacVickar, Mayor of Des Moines, Iowa, was instructed by the City Council to communicate with the manufacturers of apparatus for electric lighiing with a view to determining whether or not it would be good policy to construct an electric lighting plant for operation on municipal account. Over a fortnight ago he submitted to the Council the results of his investigation, concluding his presentation of the same in a statement of his belief that the city could profitably engage in the supply of electric current on the account indicated. He was frank enough, however, to embody in his report some replies in response to his inquiries, received from prominent concerns engaged in the manufacture of electrical apparatus, that were decidedly against the municipal idea. For instance, here are some paragraphs from the reply of the General Electric Company:

"* * * As the number of lamps required by Des Moines would be only about one-third the number in operation in Detroit, the cost per lamp [for plant, etc.] would be greater than in Detroit, and would be in the neighborhood of $500 per lamp, which, for 542 lamps, would be $271,000. I should not be at all surprised to have the figure reach $350,000. As to the cost of operation, the report by the city of Chicago, published in 1895, showed that the expense of operating each arc lamp was $95.65. To this should be added interest on investment, depreciation, insurance, taxes, water, etc., which would readily bring the price up to about $160 per lamp per year. I understand that the price in Des Moines is $99 per lamp per annum. If this is the case, it is absolutely hopeless for your city to undertake to reduce the price by putting in a plant and operating it on public account. There are plenty of consulting engineers seeking employment who can figure out that the lights will cost you $50 per lamp per annum, but such results cannot be secured either at Detroit or Chicago, and these two plants are the crack municipal plants of the country. I send you the above information from a disinterested standpoint entirely. If your city determines to put in a plant we shall be very glad indeed to bid on the electric machinery and shall try to secure the work. We shall be glad to furnish you any additional information we have on the subject. Our deliberate judgment is, however, that it will be very much cheaper and more satisfactory to your city to patronize the local company now doing business in your city for such electric lighting as it may require. The Board of Public Works, of St. Paul, Minn., have investigated the subject of municipal lighting, and have come to the conclusion that it would not be advisable to establish a municipal plant, but rather light the city's streets by contract. The Brainard (Minn.) municipal plant was a distinct failure and has been turned over to a private company. The experience of other cities, even those much larger than Des Moines, has been that the cost of street lighting has been greater when carried on directly by municipalities than when furnished by some private corporation and paid for at a fixed rate per annum. The reasons for this are many. * * *"

THE reply of the Brush Electric Light Company was:

"Your favor of the 6th is received. We have had a wide experience in selling apparatus to local electric companies furnishing lights to cities and also to municipal authorities themselves. Our experience is that there is a little too much local politics connected with the cities of this country to insure the best operation of a municipal plant. If you want some actual knowledge on this subject, suppose you write to the city of Moline, Ills. They were one of the first to try it, and one of the first to give it up. The city of Bangor, Maine, put in a plant—a first class plant—but the apparatus has never been particularly well kept up. Personally, I think that a city in this country had much better have devoted the money appropriated for buying an electric plant to the purpose of paving the streets. Paving the streets is something which you cannot buy from local companies. Other improvements which you cannot buy from local companies are more valuable to a city than an electric light plant."

ACTING on the suggestion of the Brush Company, Mayor MacVickar wrote to the Mayor of Moline, Ills., respecting the experience of that

place in the instance of municipal electric lighting, and this is the reply that was received :

"In reply to your communication of the 10th regarding electric light plant, I beg to say that this city ran its own plant for a number of years as an experiment. It was operated in connection with the water works, which made it difficult to ascertain the exact expense, and as the plant was not a modern one, and had not been taken care of in a proper manner, it was considered by our Council that the expense would be too heavy to reconstruct the plant. It was, therefore, recommended to enter into a 5 year contract with the Moline Light and Power Company, which offered $7,500 for the old plant, to apply on the first year's lighting. We pay $84 per arc light, 2,000-candle power, moonlight schedule, for 126 lamps. * * *."

DIRECTOR THOMPSON, of the Department of Public Works, Philadelphia, says that the sum of $1,500,000 will have to be expended on the municipal gas plant before it is up to the point of answering the demands even now being made upon it.

THE proprietors of the Belleville (Ills.) Gas Light and Coke Company have established the following revised schedule of selling rates: For an illuminating supply—Gross, $1.50 per 1,000 cubic feet, prompt payment (within six days) to secure the named rebates: Less than 5,000 cubic feet per month, 15 cents per 1,000 ; 5,000 to 10,000, 20 cents off ; 10,000 to 15,000, 25 cents off ; 15,000 to 20,000, 30 cents off ; over 20,000, 50 cents off. For a fuel supply—Gross, $1.25 per 1,000 ; rebates, less than 3,000 cubic feet per month, 10 cents off, per 1,000 ; over 3,000, 25 cents off. The minimum bill rendered per meter set will be 75 cents per month, less 10 cents for prompt payment.

Physiological Effects of the Rontgen Tube.

[By MR. W. M. STINE, in *Electrical World*.]

No investigator who has pursued this subject with any persistency has failed, probably, to note some more or less marked effects which long exposure to Rontgen tubes have had upon the human body. The literature of observation has grown perceptibly, but that dealing with explanations of a real scientific value has been scant. Allowing for inaccuracy of observation and exaggeration of results, it is apparent that these tubes have caused certain physiological effects with resultant pathological changes. Taken collectively these have been redness and tenderness of the skin ; the skin has become tanned as under exposure to powerful sunlight ; the hair has fallen out from the head or hand ; swelling and blistering of exposed parts ; and in a few cases the inflammation has been followed by suppuration. The significant feature in all the cases has been that the effects did not immediately follow the exposure to the tube, but there elapsed a few days, or as Prof. Elihu Thomson put it, "a period of incubation."

In the earlier days of Rontgen-ray investigations one heard little of such things, and these have become common only since the introduction of the focusing tubes. Nor can such effects be due to more violent excitation of tubes alone, rather than the character of their design, for most investigators are, if anything, employing lower voltage than formerly. Based on the writer's experience, the old type of pear-shaped, glass intact tubes did not have any permanent effects on the human body, nor were such detected until the focus type was adopted.

In order to obtain a rational explanation for the pathological changes, the attempt will be made to show that they all probably result from one general effect of the Rontgen ray on the body—that of stimulation. This, however, will not directly account for the tanning of the skin. When the tube is placed but a few inches from the skin and kept in that position for at least one half hour, in a few days a discoloration of the skin takes place. The result in all its symptoms seems identical with sunburn, and whether the Rontgen ray be ultra-violet light or not, it is well established that such tubes emit ultra violet light from secondary actions taking place within them. These actinic rays are capable of producing all the effects which follow exposure to sunlight.

From a medical standpoint inflammation results from an increased local activity of the circulation of the blood. Cohnheim found upon stimulating the tongue and mesentery of a frog that the blood vessels dilated. After a time the white corpuscles lined their walls and began to pass through them into the adjacent tissues. Once escaping from the blood vessels, the leucocytes, through their well known amœboid movements penetrated the tissues. Coincident with the emigration of the leucocytes, the fluid constituents of the blood filtered through the walls of the blood vessels by osmosis. Virchow, another eminent authority claims that in cases where such emigration has occurred the white corpuscles may break down into pus cells.

From some early investigations with Rontgen rays the writer was led to conclude that the immediate and perhaps only effect on the body was one of stimulation, and that this affected chiefly the white corpuscles, causing them to quicken their amœboid movements and emigrations, and possibly their proliferation, the action being in general a tonic one. This certainly accounts for the therapeutic effects which these rays have been found to possess. The view here advanced received striking confirmation when the superficial bodily effects are studied. For example, suppose the hand is held near a powerfully excited tube of the focus type for half an hour. The sensations accompanying the exposure are those of heat and stimulation. In the course of a few days the hand grows red and swells, and perhaps blisters will form, and in some cases suppuration may intervene. Seemingly during the exposure the leucocytes were greatly stimulated and began an emigration through the dilated walls of the blood vessels, venus and arterial. During the latent period, lasting over a few days, these leucocytes permeated the tissues and perhaps proliferated to some extent. Co-existing with these changes an exudation of serum took place, causing swelling. The presence of the leucocytes in the tissues would explain the symptoms of heat and pain in the parts affected. This condition of inflammation would continue until the white corpuscles and serous exudations were absorbed, a process which is always a tedious one at best.

So far this explanation is hypothetical and is worthy of serious attention chiefly from that it is based on certain well established facts connected with similar inflammations produced by other causes. The demonstration must rest with the biologist, and a very inviting field is here presented to him. The final test would be a microscopical examination of amœbæ and leucocytes while under exposure to the Rontgen ray.

If the activities of such life-forms were seen to be quickened and their proliferation stimulated, what is here but hypothesis, would in all probability become established fact, since the general physiological effects and pathological changes referred to have been fully demonstrated and are generally accepted.

The interesting question would then occur, is such stimulation an immediate effect of the ray due to an absorption of energy, or is it brought about by some chemical change within the cell body, or the fluids in contact with them ? And further, to what extent, if any, are the more highly organized tissues stimulated ?

The Cost of Heating Rooms by Gas.

In an interesting letter on this subject, contributed to the London *Journal* some time ago by Mr. Thomas Fletcher, F.C.S., whose fame as a manufacturer of appliances for cooking and heating by gas is world-wide, says :

Some curious statements are going the round of the papers ; and they are so misleading in every way that it will be well to recall the result of a series of elaborate trials made continuously by myself for a period of twelve months, under exact conditions. The full report of these experiments was published in the *Brewers' Journal* for April 15, 1895, as the experiments were undertaken specially to determine the cost of heating brewers' bottling and conditioning stores ; and the figures obtained are well worth preserving, as a basis for calculation for all rooms kept at a regular temperature night and day. It was found that the heat required had not the slightest relation to the cubical capacity of the room ; this depended entirely on the area of the wall surface and on the ventilation. Several rooms were tested ; and it was found that, of the total heat evolved, from 75 to 87½ per cent. was absorbed by the walls and ceiling, where the ventilation was limited. Only 12½ per cent. of the total heat was used in warming the air, and the rule was discovered that, for every 1,600 square feet of wall surface, excluding the ceiling, a gas consumption of 1 cubic foot per hour maintained a rise of 1° F., when the air in the room was changed every hour. If the air is entirely renewed every 20 minutes, 37½ per cent., or a little more than one-third, was used in warming this air, and the gas consumption for the same result rose to 1¼ cubic feet per hour for every 1° rise maintained.

Of course, if the temperature of a room has to be raised quickly, the proportion of heat absorbed by the walls increases enormously, as does the gas consumption ; but the fact remains that, whatever the heat required to warm the walls, and lost in this way, the heating of the air required only 1 cubic foot per hour for every 1,600 square feet of wall surface, for every 3° F. rise of temperature, when the whole of the air in the room was entirely renewed every 20 minutes—a fair average for ordinary living rooms. When a room has to be warmed quickly—say 20° F.—the proportion of gas used in warming the air becomes infinitesimal, as, whatever the heat absorbed by the walls, that taken up by the air, and retained by it, never varies.

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MONDAY, DEC. 28, 1896.

The Market for Gas Securities.

The market for city gas shares continues dull and depressed, the most notable shrinkage having occurred in Consolidated, which, at noon to-day (Thursday) sold at 140½. This represents a loss for the week of 10 points, or a loss from the highest mark (reached about a fortnight after the election) of 28 points. Other marked declines are shown in Equitable and Mutual. The belief is widespread that the next Legislature will be a meddlesome body in respect of gas rates, not only in so far as these apply to New York city and Brooklyn, but to the other populous centers of the State as well. The Special Committee of the Board of Aldermen of this city, whose instructions are to investigate the entire question of gas manufacture and supply, with a view to incidentally determine whether or not the city should assume the business on municipal account, will also be a disturbing factor; so, on the whole, the outlook for a speedy return to normal values in gas shares is most unpromising.

In passing it might be well to note that the testimony, so far had before the Senate Committee of Pennsylvania, in their investigation of the operations of the Philadelphia municipal gas works, is eloquent in condemning the concern on every side. As careful an expert and as accomplished a gas engineer as Mr. Vanderpool, who appeared before the Committee this week, testifies that each 1,000 feet of gas sold by the Bureau at $1 actually costs the Bureau, on a fair estimate of the charges pertaining to distribution and manufacture, $1.36 per 1,000. Still, the municipal managers say that the business is carried on at a profit. All bubbles shine and soar, until they are pricked. Brooklyn Union gas is weaker, in sympathy with the New York shares. Chicago is weaker, in common with the general market. Bay State is steady, and Lacledes are firmer. The situation as a whole, outside of New York, favors the nvestor.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

DEC. 28.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	140	141
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	194	200
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	230	235
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	41	42½
Preferred	2,000,000	100	70	72
Bonds 1st 5's	3,500,000	1,000	105	106
" 1st Con. 5's	1,500,000	..	94	96
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	83	86
Preferred	5,000,000	100	106	..
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109½	..
Yonkers	299,650	50	180	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	87	89½
" " Bonds (5's)	15 000,000	1,000	105½	106
Bay State	5,000,000	50	11	11¼
" Income Bonds	2,000,000	1,000	25	30
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000		76
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	72⅞	73
Chicago Gas Lt. & Coke Co.				
Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	70	75
" Bonds	600,000	1,000	100	102
Cincinnati G. & C. Co.	7,000,000	100	201⅛	202
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	62	63
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds	4,312,000	..	..	82
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	84	86
" Bonds	2,000,000	..	85	90
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	128	133
" Bonds, 6's	2,650,000	..	103	105
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	82	83
Bonds	1,000,000	1,000	85	90
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	25⅝	25¾
Preferred	2,500,000	100	70	72
Bonds	9,034,400	1,000	93	..
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	98	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10.000,000	100	97¾	98¼
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500.000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	63	65
Bonds, 5's	3,556,000	.	90	93
Wilmington, Del.	500,000	50	180	183

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Management of Small Gas Works.....1026
Handbook on Gas Engines.....1014
Gas Flow Computers.....1024
Hughes' "Gas Works".....1024

ENGAGEMENT DESIRED.

An English Gas Engineer and Chemist, late teacher of gas manufacture, "City and Guilds of London Institute," author of numerous papers, thoroughly up to date in all departments of coal, oil and water gas, gas lighting, heating, working of residuals, etc., is open to accept appointment as Superintendent, Representative (to reliable firm) or Examiner. Highest references and testimonials as to ability, training, etc. Address, with particulars,

1122-5 "G. A.," care this Journal.

Position Desired

As Superintendent of Gas Works or Gas and Electric Light Works,

By a man 34 years of age. Sixteen years' experience in the manufacture and distribution of Coal Gas as Supt., and four years in the Electric line. Thoroughly competent to take charge of any plant, separately or combined. A practical mechanic, and understands the erection of gas plants and everything pertaining to the business. Not afraid of work. Salary no object until ability is proven. Best of references.

1102-tf Address "M. E. J.," care this Journal.

FOR SALE.

Hydraulic, Dip, Branch and Ascension Pipes, Mouthpieces and Lids, for four Benches of 5's and for one Bench of 3 retorts.
Two Coolers, or Air Condensers, each of 150 000 cubic feet capacity.
Multitubular Condenser, shell, 36 in. diameter, with 98 2-in. tube, 10 ft. 6 in. long.
D-Shaped Tar Extractor, 8 ft. long, 1 ft. 6 in. deep.
Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three manholes, 11 in. by 15 in.
S-inch Center Seal. Four Purifiers, 8 ft. x 6 ft.

KEY CITY GAS CO.,
1119-tf Dubuque, Iowa.

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., DREXEL BUILDING, PHILA., Dec. 21, 1896.

The Directors have this day declared a quarterly dividend of 2 per cent. ($1 per share), payable on Jan. 15, 1897, to stockholders of record at the close of business Dec. 31, 1896. Checks will be mailed.

1125-3 EDWARD C. LEE, Treas.

WANTED,

Man Capable of Taking Entire Charge of Gas Plant,

in favorable location, sending out about 25,000,000 cubic feet. Give qualifications and reference. Address

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FOR SALE.

Interest in Coal Gas Plant in Town of 15,000 Population,

with an adjoining town one mile away of 15,000. Works located in Michigan. Small capital required for extension of mains. Control can be had if desired; owner has other interests and cannot attend to both. Plant new. Great chance for man with small capital, if taken at once. Address

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For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

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1097-tf Fort Wayne, Ind.

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Gas Engineer, wishing change of location, would like engagement as Agent, Manager or Superintendent.

Address "J.,"
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Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.
Ammonia Concentrator.
Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
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SOLE IMPORTER OF THE CELEBRATED

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Stettin "Anchor" & "Eagle" Brand Portland Cement
10 & 12 Old Slip New York.

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(Established 1870.)
SOLE MANUFACTURER OF THE
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E. H Nickel Tips for Water Gas a Specialty.
THEO. CLOUGH, - - Dobbs Ferry, N. Y.

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Made in all sizes.

Will cut from 2 in. to 24 in.
Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.
WM. ANDERSON,
425 Meridian Street,
EAST BOSTON, MASS., or
WALDO BROS.,
88 Water Street, Boston, Mass.

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For Our First-class Burners at 20 Cents.
For Our First-class Mantles at 10 Cents.
Warranted in Writing to Violate no other Patents

All articles for Incandescent Light good and cheap. Send for Price Lists.

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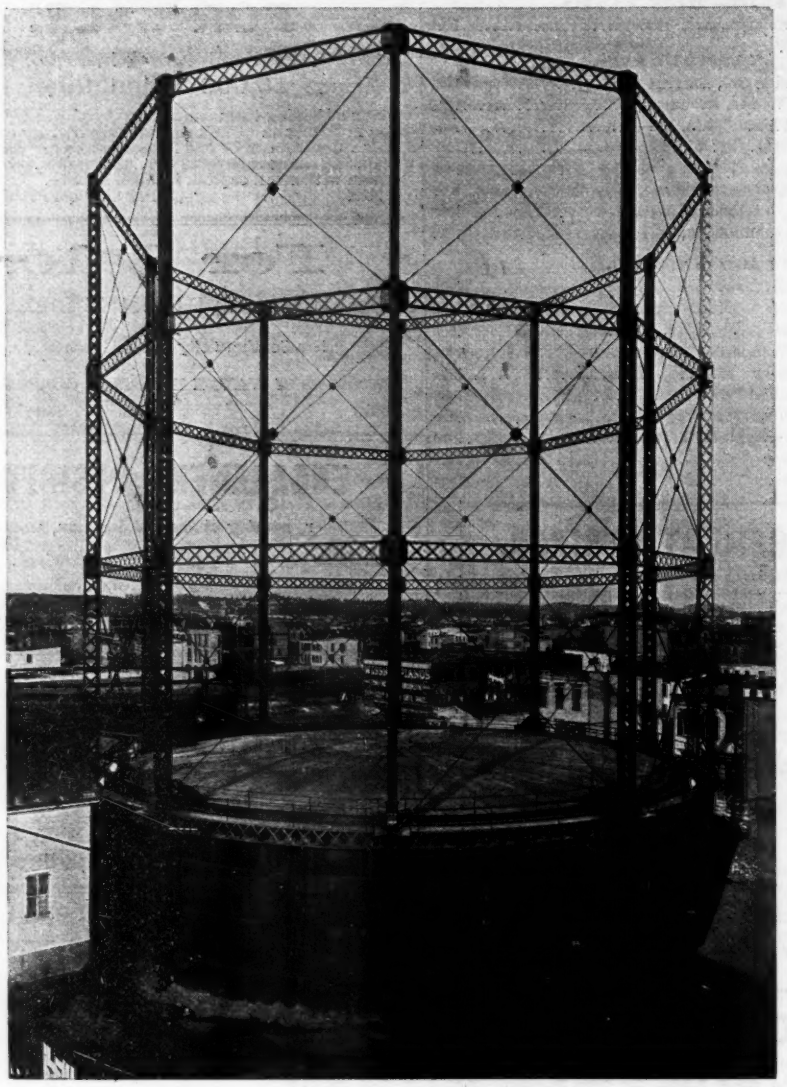
The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu. Ft.



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Brooklyn, N. Y.

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Complete with Steel Tanks.

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Self-Sealing Retort Lids,
AND ALL PARTS OF
GAS WORKS APPARATUS.

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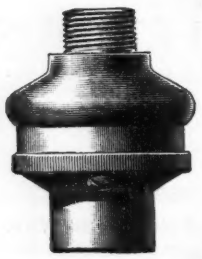

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WILDER'S VOLUMETRIC GOVERNORS.

They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.

WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.

THE WILDER MANFG. CO., - - 818 Cherry St., PHILADELPHIA.

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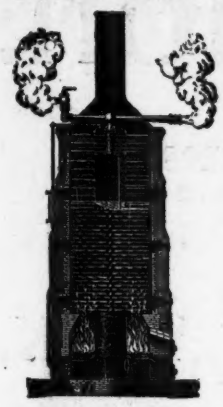

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After Sixteen Years of Active Service in all the Principal Industries, this Boiler has Proven Itself Superior to all Others in Economy of Fuel, Durability, Safety and General Efficiency.

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CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

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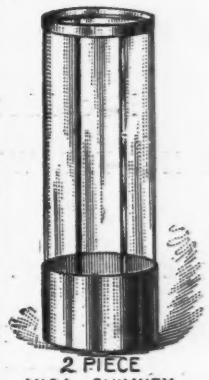

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AMERICAN GAS COMPANY,

222 South Third Street, Philadelphia, Pa.

Owns, Operates, Buys and Leases Gas Works.

ALSO UNDERTAKES ALL KINDS OF CONSTRUCTION WORK.

Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

CORRESPONDENCE RESPECTFULLY SOLICITED. Address

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The Gas Exposition.

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To be He'd at MADISON SQUARE GARDEN, NEW YORK,

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Eugene Vanderpool, Newark, N. J.
Capt. Wm. H. White, New York.
Dr. Wm. H. Wahl, Philadelphia.
Walter Wood, Philadelphia.

The Gas Associations have Appointed the Following Representatives:

W. M. EATON, Michigan Gas Asso. **J. A. BRITTON, Pacific Coast Gas Asso.** **IRVIN BUTTERWORTH, Ohio Gas Light Asso.** **GEO. T. THOMPSON, Western Gas Asso.**

C. J. R. HUMPHREYS, American Gas Lt. Asso. **C. H. NETTLETON, New England Asso. of Gas Engineers.**

Every indication points to the attendance of gas men from near by as well as from the most remote sections of the country. Arrangements are now under way for providing hotel and railway facilities for members of the gas fraternity who may wish to visit New York during the Exposition.

Several New York hotels have offered special rates.

Full particulars on these points will be given very shortly.

The Historical Exhibit will embrace many articles of surpassing interest. A celebrated collection of ancient lamps and lighting appliances, consisting of several hundred rare specimens never exhibited outside the great institution in which the collection is now lodged, is promised.

GAS MEN'S NIGHT.

The Ohio Gas Light Association will hold its annual meeting in this city during the Gas Exposition. Date, February 3 and 4. The management has designated Wednesday evening, February 3, as **Gas Men's Night.** A programme will be made up covering this feature that will appeal to all as befitting the occasion.

THE TIFFANY GAS TOWER,

With its Myriad of Lights and Beautiful Decorative Effects. Worth a Thousand Mile Journey to See.

INJUNCTION ISSUED AGAINST INFRINGERS.

On September 23d the United States Circuit Court for the Southern District of New York granted an injunction restraining and enjoining the further infringement of our Welsbach patent. READ IT.

UNITED STATES CIRCUIT COURT,
Southern District of New York.

WELSBACH LIGHT COMPANY,
vs.
A. LIEBES.
} IN EQUITY.

The President of the United States,

To A. LIEBES, and his servants, agents, attorneys and workmen, GREETING:

WHEREAS, It has been represented to us in our Circuit Court of the United States for the Second Circuit and Southern District of New York, that Letters Patent of the United States No. 438,125, were issued in due form of law on the 7th day of October, 1890, to Carl Auer von Welsbach, assignor of the complainant, then known as "Welsbach Incandescent Gas Light Company of New Jersey," and that the complainant herein is the owner of said Letters Patent, and that you, the said A. Liebes, have infringed the rights secured by the aforesaid Letters Patent, by making, using and selling to others to be used, incandescent devices for gas burners, embodying and containing the invention and improvements described and claimed in said Letters Patent No. 438,125.

NOW, THEREFORE, We do strictly command and enjoin you, the said A. Liebes, and your attorneys, agents, servants and workmen, under the penalties which may fall upon you in case of disobedience, that you forthwith and forever desist from directly or indirectly making, or causing to be made, delivering, vending, or causing to be sold, offering for sale, using, or causing to be used in any manner, any incandescent devices for gas burners, like, or similar to those which you have heretofore made, used or sold, containing or embodying the invention and improvements described in said Letters Patent No. 438,125, and claimed in the claim thereof, and from counterfeiting or imitating the said invention or improvements or any part or parts thereof, and from in any manner or way whatsoever, violating or infringing the said Letters Patent No. 438,125 and the claim thereof, and from doing, or causing to be done, any other act or thing whatsoever in infringement of the said Letters Patent No. 438,125.

WITNESS, The Honorable Melville W. Fuller, Chief Justice of the United States, at the City of New York, in the Southern District of New York, this twenty-fourth day of September, A. D., 1896.

(SEAL) JOHN A. SHIELDS, Clerk.

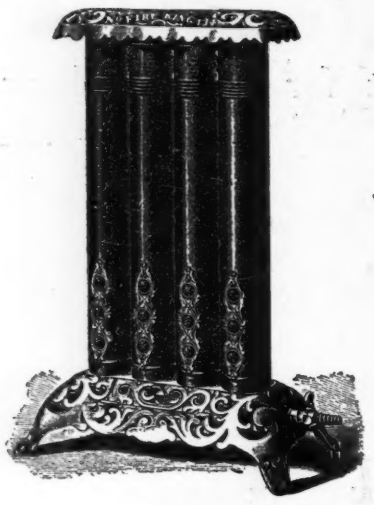
(Endorsed) U. S. Circuit Court, Southern District of New York, in Equity.—Welsbach Light Company vs. A. Liebes. Injunction.

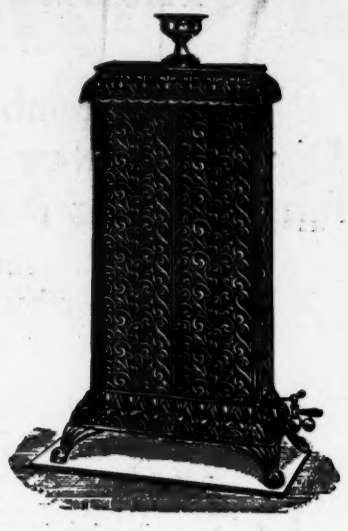
A Copy of a Writ of Injunction this day issued out of my office. JOHN A. SHIELDS, Clerk.

We shall proceed against all infringers; manufacturers, dealers and users being equally liable to injunction and damages. The decree of the court awarding the injunction also awards profits and damages. Do not be misled or deceived by guarantees offered by infringers, as such guarantees will not protect you against suit, injunction and damages. For your own protection see that you get the genuine Welsbach light. All other incandescent gas lights are infringements.

WELSBACH LIGHT COMPANY.

FIRE KING GAS HEATERS.





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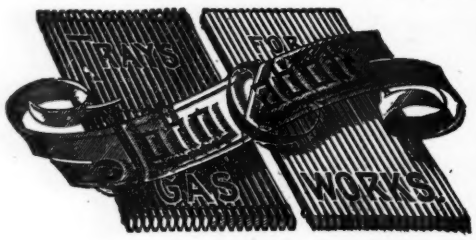

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Their Construction and Arrangement,

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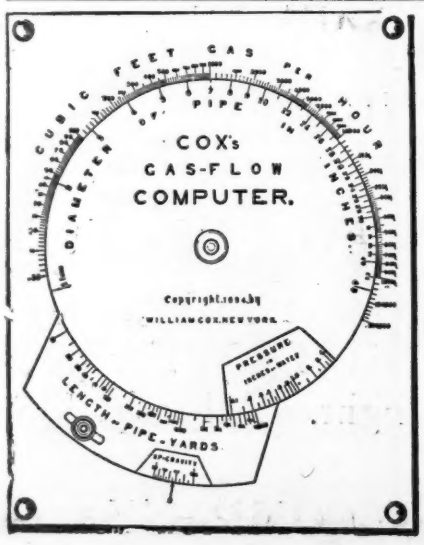

Cox's Gas Flow Computer.

1. It gives at a glance the discharge of gas from pipes 1 to 48 inches in diameter and 10 to 10,000 yds. long, for any pressure from 0.01 to 10.0 inches of water, and any specific gravity from 0.40 to 1.00.

2. When the required discharge and the length of pipe are given, the diameter corresponding to any pressure is at once seen.

3. When the required discharge and the length of pipe are given, the pressure corresponding to any diameter is at once found.

4. Any suitable combination of the different factors of any problem, under all possible conditions, may be immediately found.

It Prevents Errors and Saves Hours of Tiresome Calculations.

Price, $5.00, per Registered Mail.

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Jewel Gas Stoves

For 1897

WILL BE THE TALK OF THE TRADE!

New Stoves, with New Features.
Nothing Like Them. . . . . .

The buyer who considers Quality first, and makes Price a secondary consideration, is the successful one, because he pleases his trade and thereby increases his business. **JEWELS** are leaders in Mechanical Perfection. Our Catalog will be ready about February 1st. Send for a copy **now** and we'll have you on the list.

GEORGE M. CLARK & COMPANY, 161 Superior St., Chicago.

When writing, mention this Paper.

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Coal and Water Gas Plants,

OWN SYSTEM.

Recuperative Furnaces, Washers, Condensers, Purifiers, Purifying Machines.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

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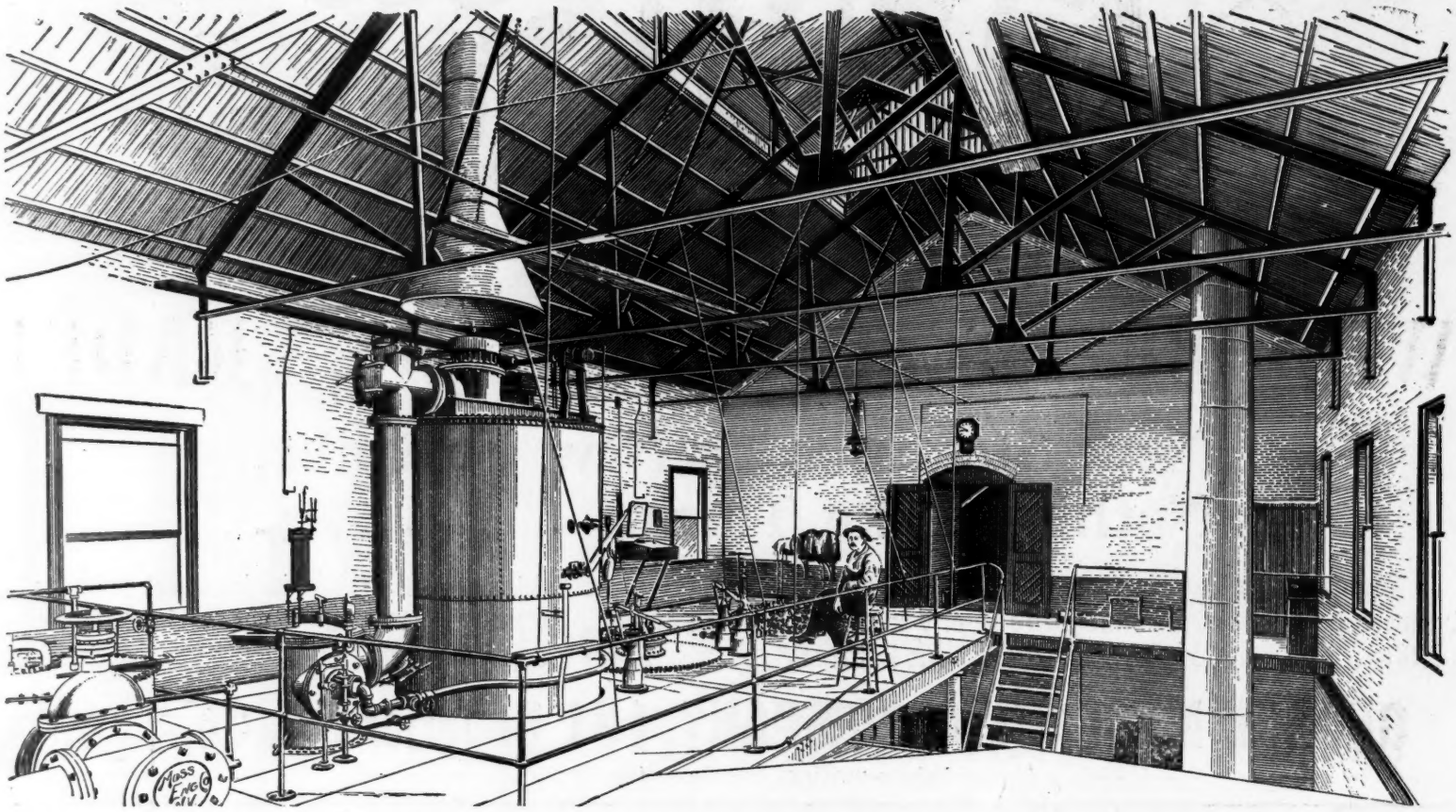

The above illustration is taken direct from a photograph, and shows the Machine Room of the New Bedford Gas Co., at New Bedford, Mass. The Roof of this building was furnished by us. The building is 32 feet wide by 150 feet long, the Roof being made entirely of iron—that is, iron trusses and iron purlins covered with corrugated iron. The room is ventilated by a wrought iron ventilator extending the full length of the building, with corrugated Iron shutters on each side opening and closing by cords from the floor.

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THE MANAGEMENT OF SMALL GAS WORKS.

By C. J. R. HUMPHREYS.

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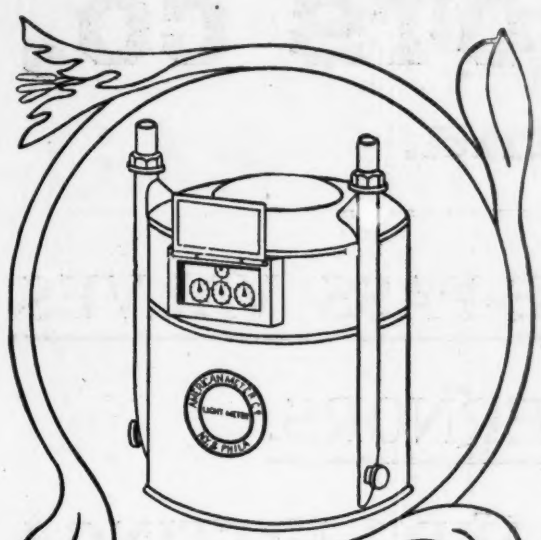

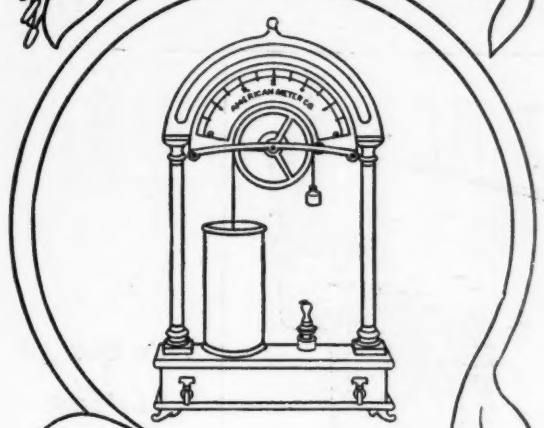

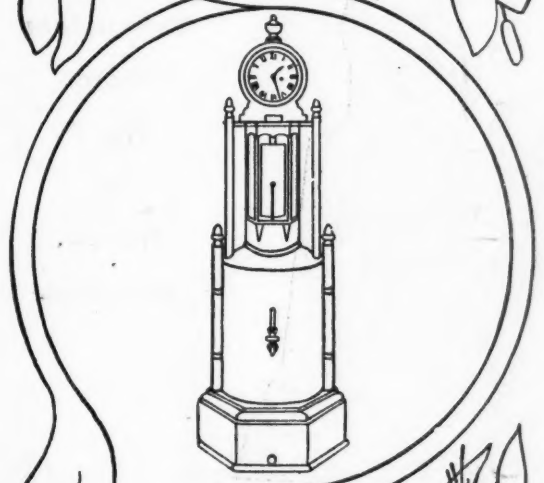

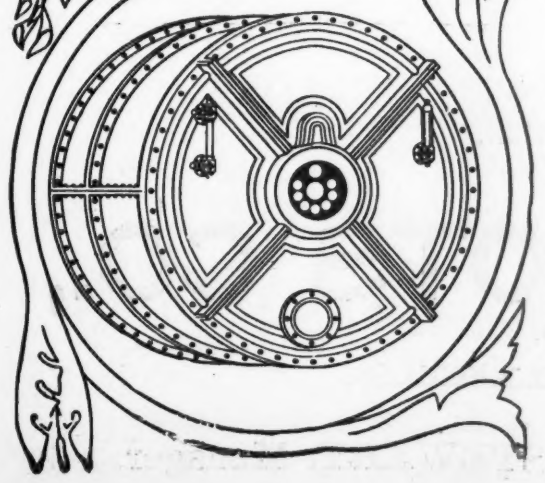

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SAN FRANCISCO.

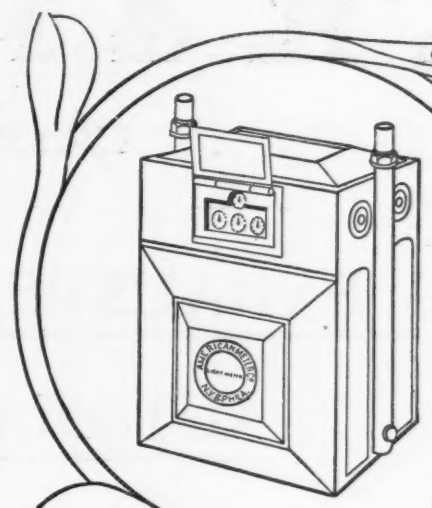
PUBLIC LIGHTING TABLE.

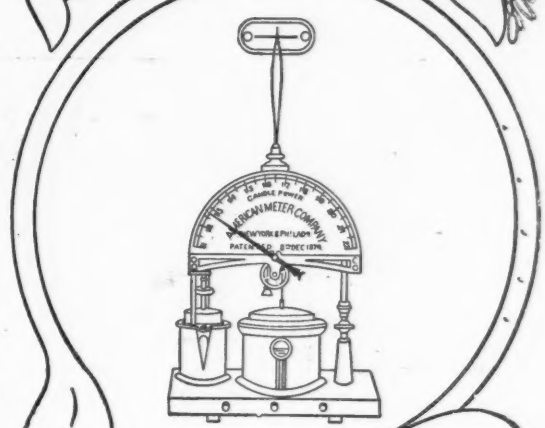
JANUARY, 1897.

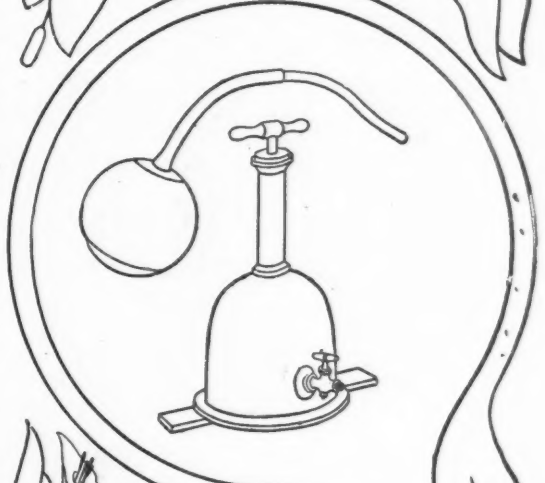
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Fri.	1	5.10 PM	6.20 AM	4.30	6.30
Sat	2	5.10 NM	6.20	4.30	6.30
Sun.	3	5.20	6.20	4.30	6.30
Mon.	4	5.20	6.20	4.30	6.30
Tue.	5	5.20	6.20	4.30	6.30
Wed.	6	5.20	6.20	4.30	6.30
Thu.	7	8.50	6.20	4.30	6.30
Fri.	8	9.50	6.20	4.40	6.30
Sat.	9	10.50	6.20	4.40	6.30
Sun.	10	11.50 FQ	6.20	4.40	6.30
Mon.	11	12.50 AM	6.20	4.40	6.30
Tue.	12	1.50	6.20	4.40	6.30
Wed.	13	2.50	6.20	4.40	6.30
Thu.	14	3.50	6.20	4.40	6.30
Fri.	15	4.50	6.20	4.50	6.25
Sat.	16	5.40	6.20	4.50	6.25
Sun.	17	No L.	No L.	4.50	6.25
Mon.	18	No L. FM	No L.	4.50	6.25
Tue.	19	No L.	No L.	4.50	6.25
Wed.	20	5.40 PM	8.20 PM	4.50	6.25
Thu.	21	5.40	9.30	4.50	6.25
Fri.	22	5.40	10.40	5.00	6.25
Sat.	23	5.40	11.50	5.00	6.25
Sun.	24	5.40	1.10 AM	5.00	6.25
Mon.	25	5.40 LQ	2.20	5.00	6.25
Tue.	26	5.40	3.40	5.00	6.25
Wed.	27	5.40	4.50	5.00	6.25
Thu.	28	5.40	5.50	5.00	6.25
Fri.	29	5.40	6.10	5.05	6.15
Sat.	30	5.40	6.10	5.05	6.15
Sun.	31	5.50	6.10	5.05	6.15

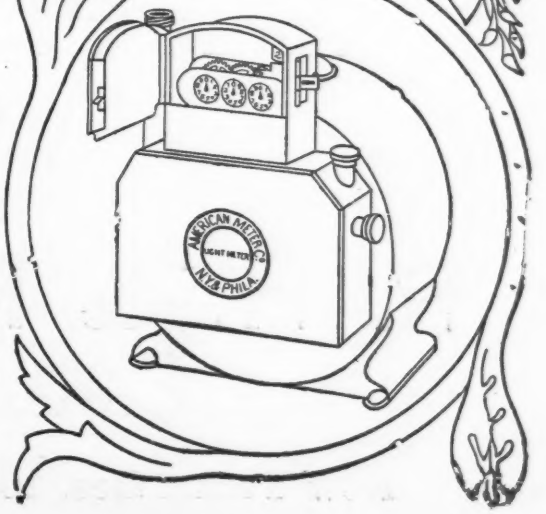
TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	233.00	January	423.20
February	187.20	February	355.25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45









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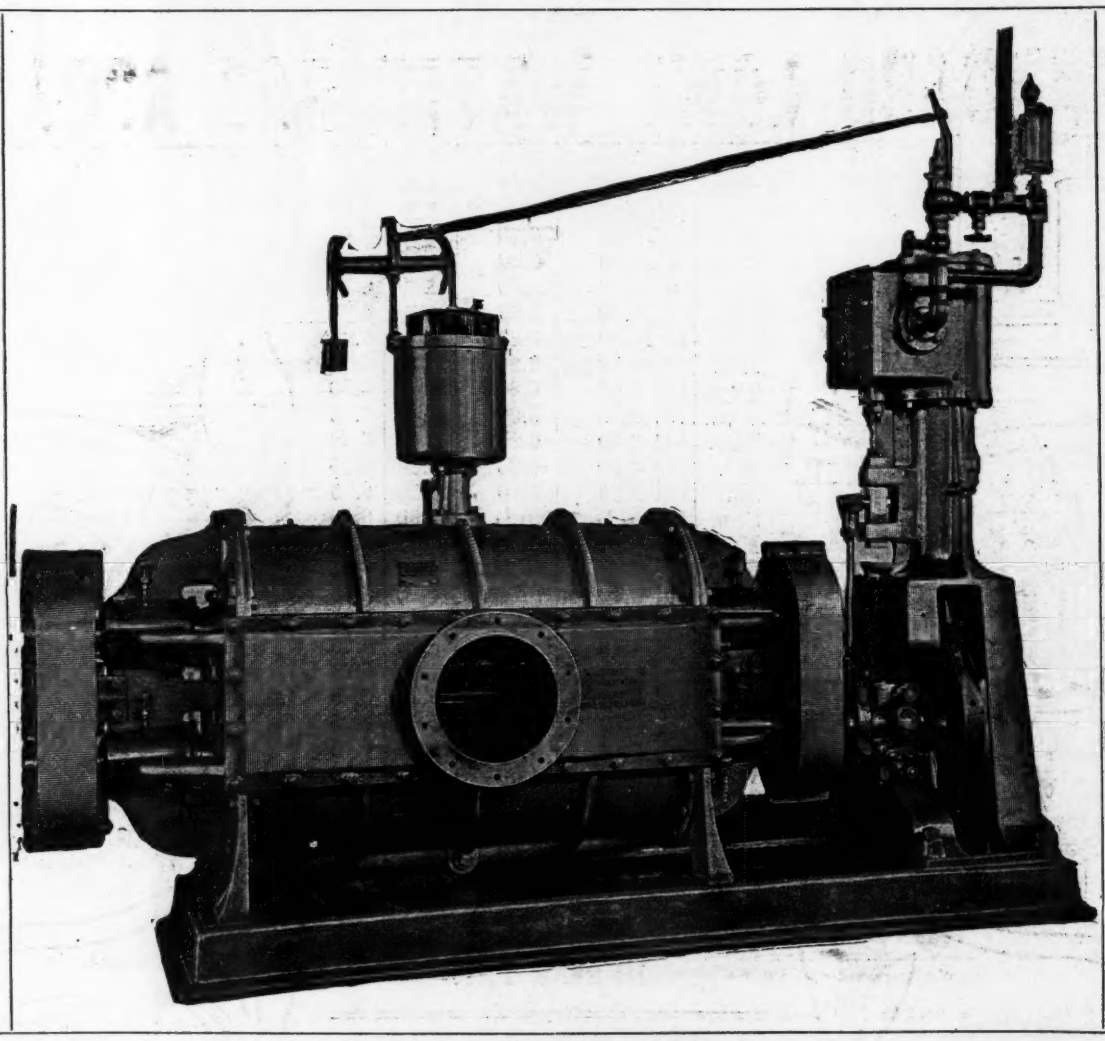

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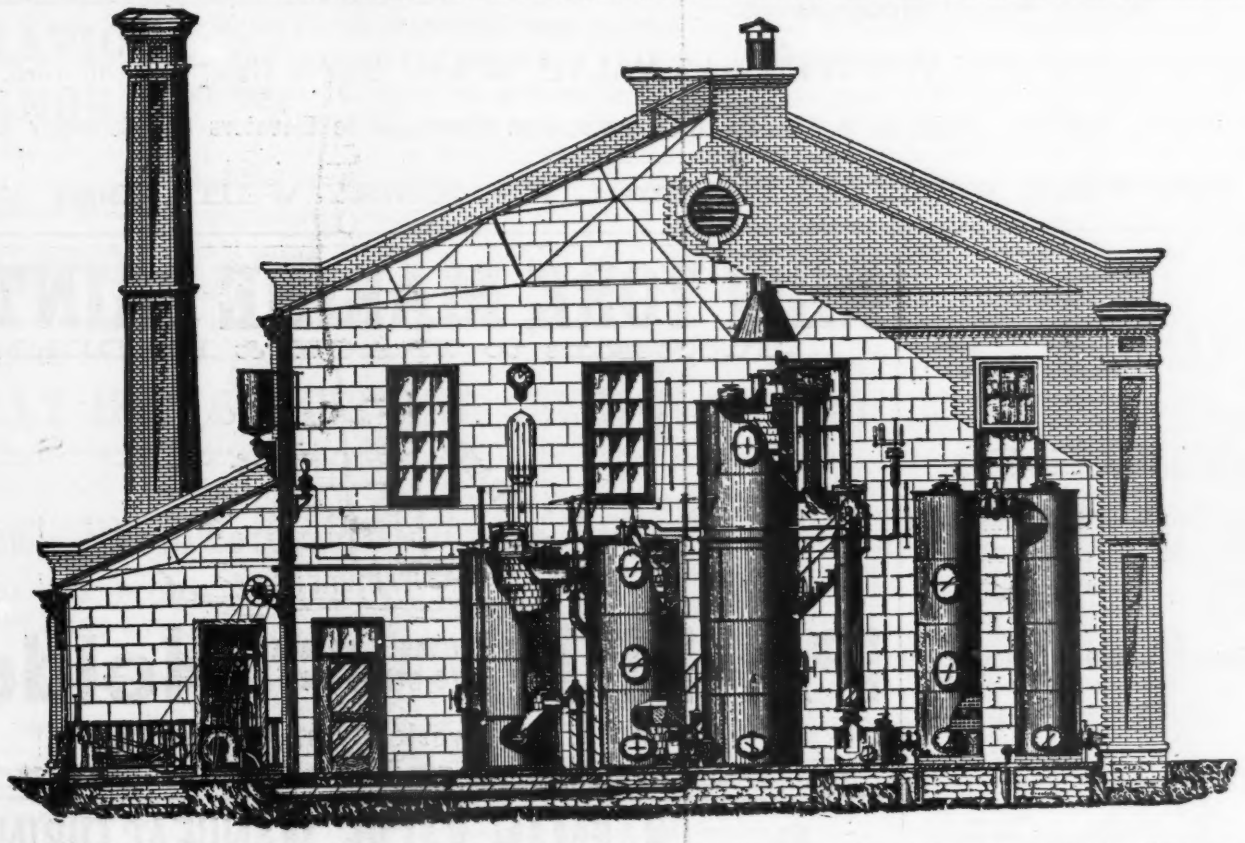

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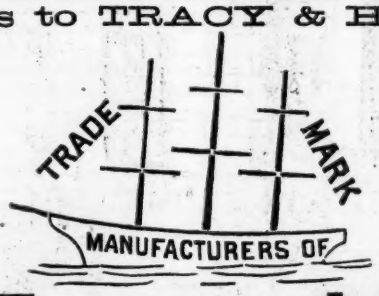

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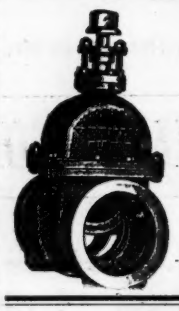

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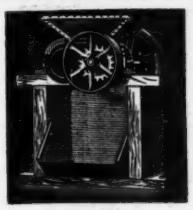

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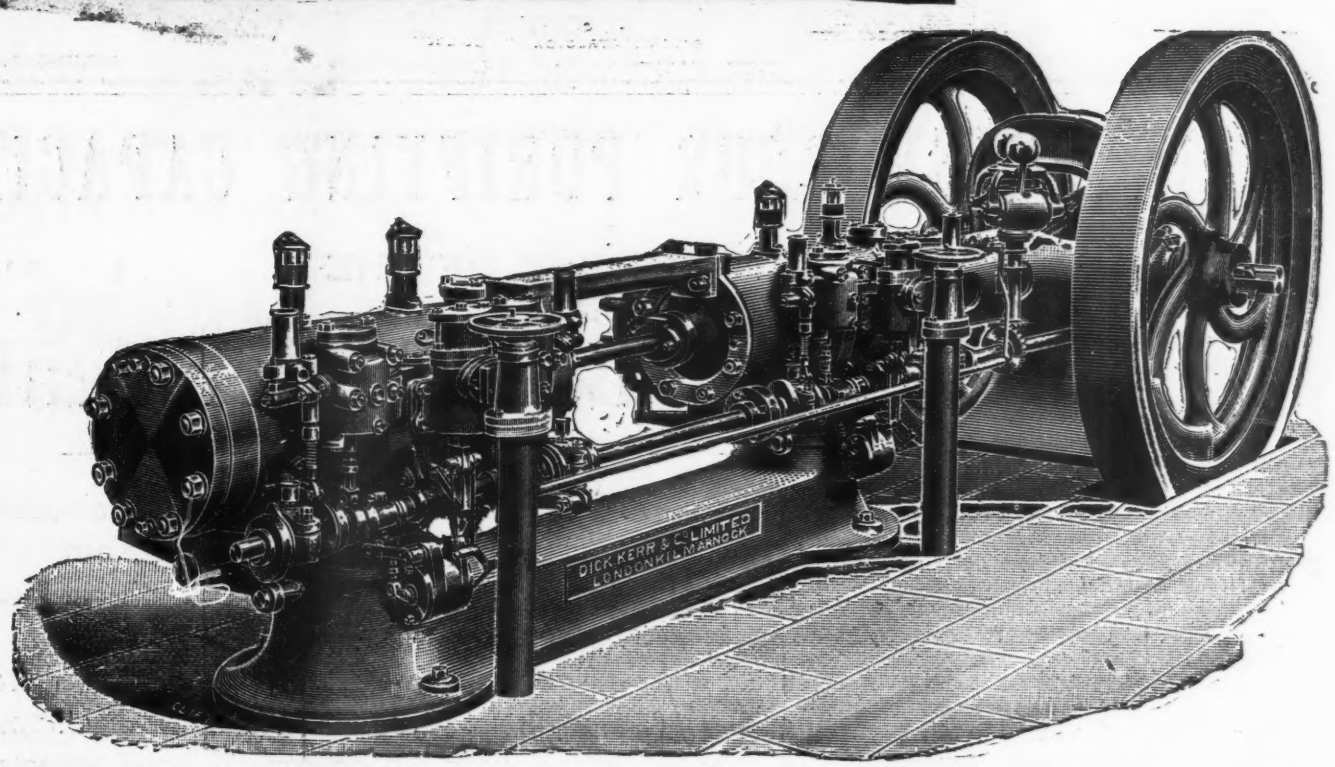

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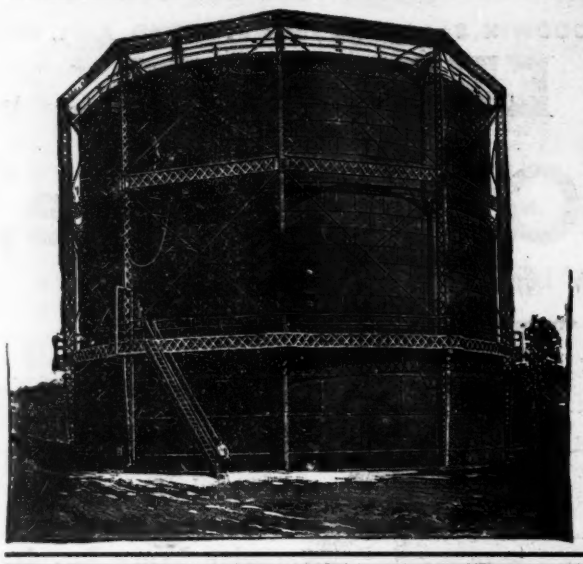

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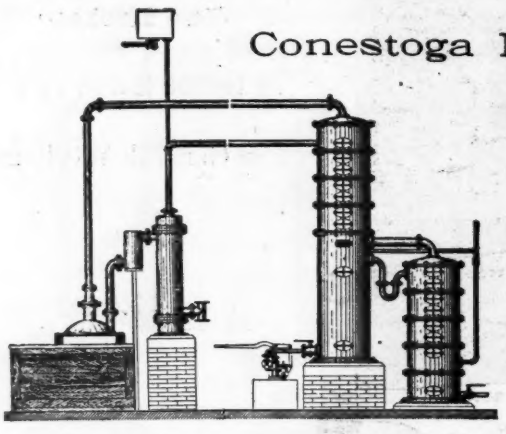

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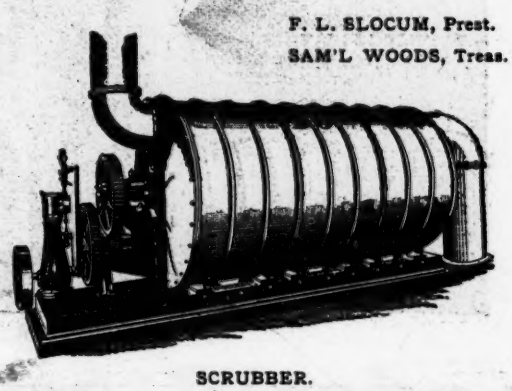

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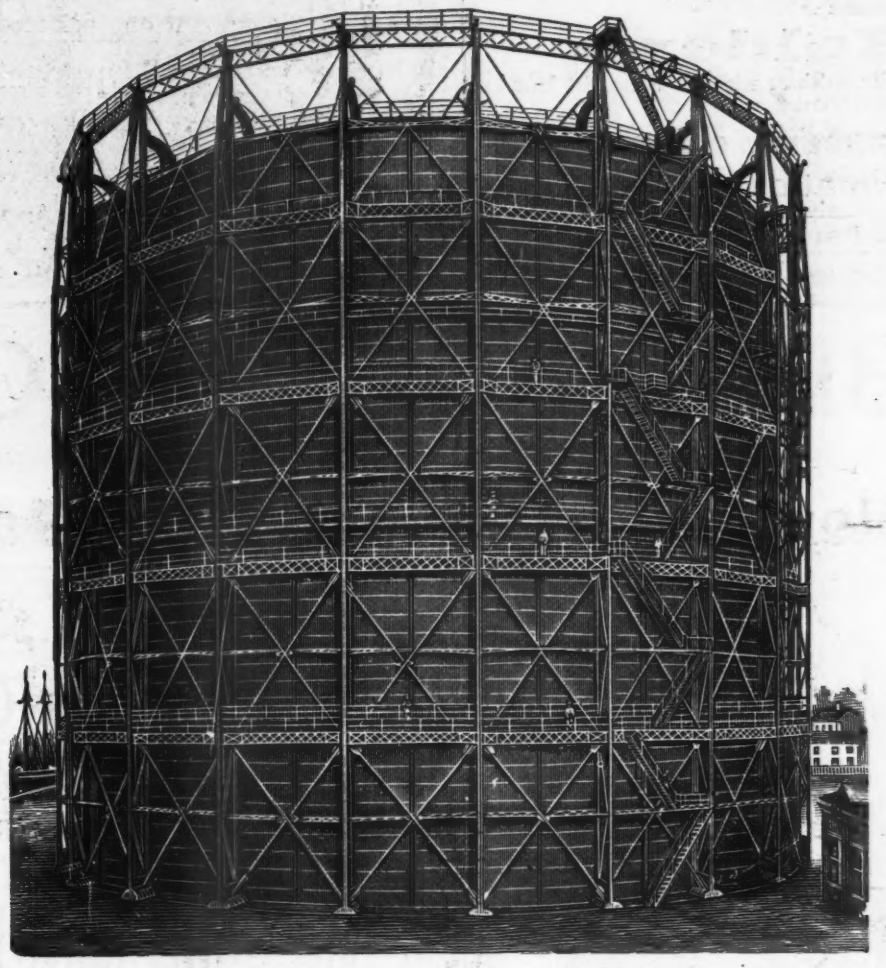

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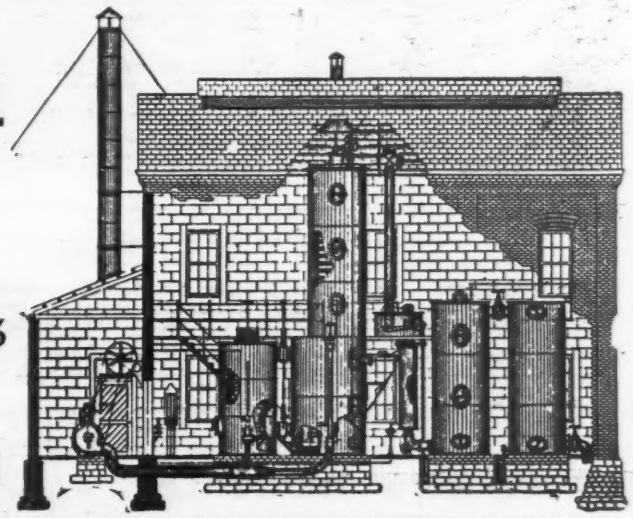

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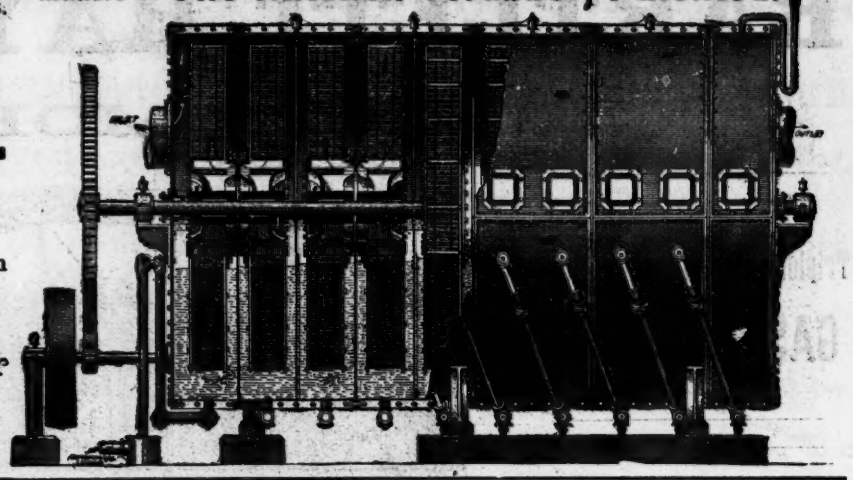

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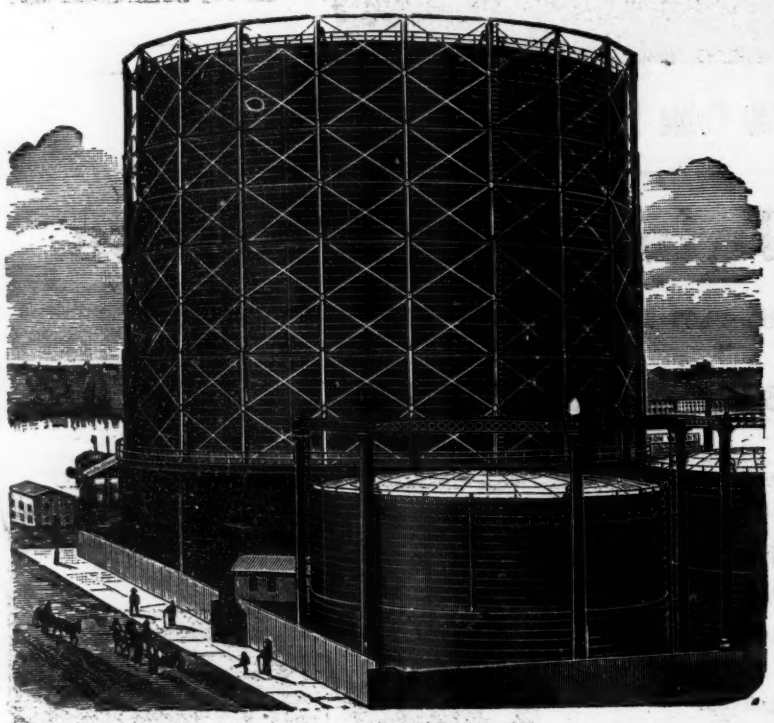

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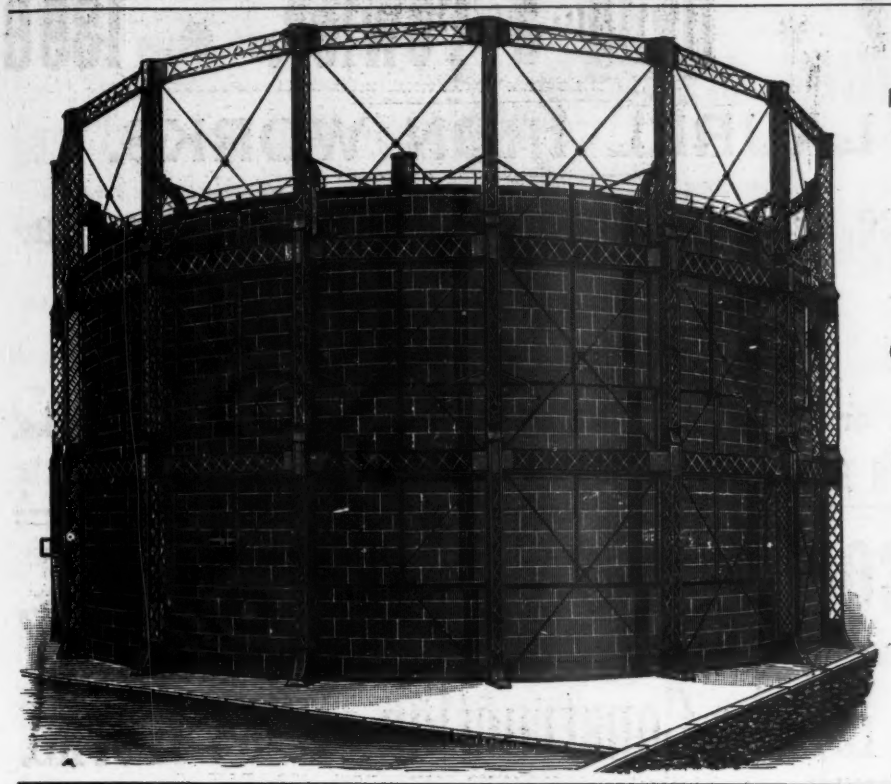

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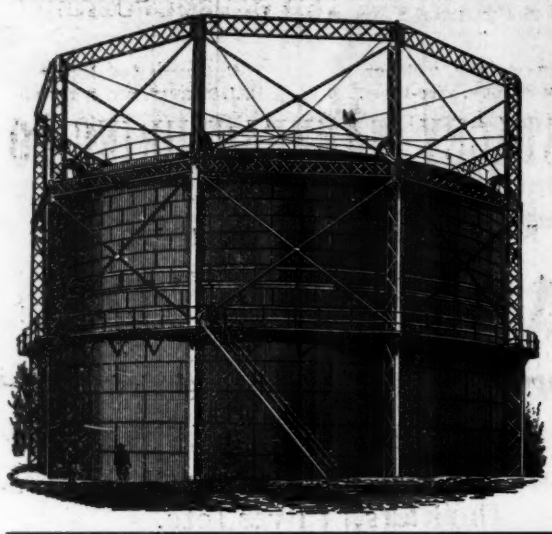

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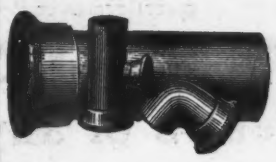

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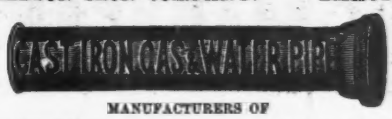

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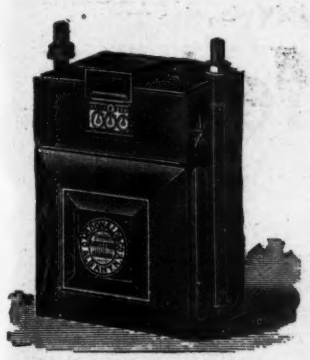

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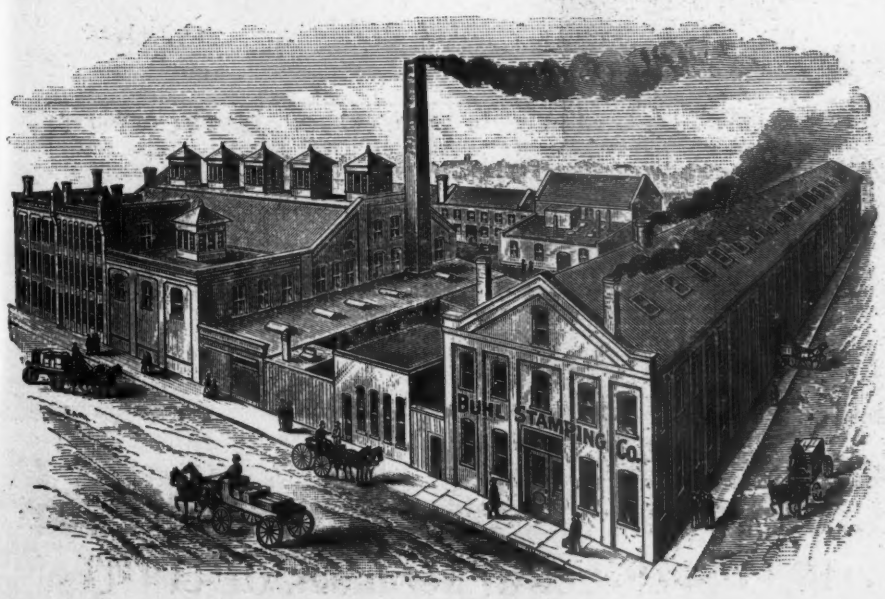

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